BULLETIN

OF THE

TORREY BOTANICAL CLUB

VOLUME 53

FOUNDED BY WILLIAM HENRY LEGGETT 1870

EDITOR

TRACY ELLIOT HAZEN

ASSOCIATE EDITORS

ALBERT FRANCIS BLAKESLEE
CORNELIA LEE CAREY
ALEXANDER WILLIAMS EVANS
HENRY ALLAN GLEASON
ALFRED GUNDERSEN
GEORGE TRACY HASTINGS
MARSHALL AVERY HOWE
MICHAEL LEVINE
ARLOW BURDETTE STOUT
SAM FARLOW TRELEASE

NEW YORK

1926–1927

PUBLISHED FOR THE CLUB
THE INTELLIGENCER PRINTING COMPANY
LANCASTER, PENNSYLVANIA

General (Sci. Lib.)
Wahr

CONTENTS

PICKETT, FERMEN LAYTON, and MILDRED EUNICE MANUEL. An ecological study of certain ferns: *Pellaea atropurpurea* (L.) Link and *Pellaea glabella* Mettenius 1
GLEASON, HENRY ALLAN. The individualistic concept of the plant association 7
ASHE, WILLIAM WILLARD. Notes on *Tilia* 27
OSTERHOUT, GEORGE EVERETT. New plants from Colorado 35
BERRY, EDWARD WILBER. *Terminalia* in the lower Eocene of southeastern North America 59
ORTON, WILLIAM ALLEN. Botanical problems of tropical agriculture 67
BLIZZARD, ALPHEUS WILLIAM. The nuclear phenomena and life history of *Urocysistis Cepulae* (PLATES 1–4) 77
SHREVE, FORREST. The desert of Baja California 129
TRELEASE, SAM FARLOW, and HELEN MARY TRELEASE. Toxicity and antagonism in salt solutions as indicated by growth of wheat roots 137
DAYTON, WILLIAM ADAMS. On *Lupinus fraxinetorum* Greene (PLATE 5) 157
RYDBERG, PER AXEL. Notes on Fabaceae—VII 161
HARRIS, JAMES ARTHUR. The specific electrical conductivity of the leaf tissue fluids of phanerogamic epiphytes 183
SCHAFFNER, JOHN HENRY. The nature and cause of secondary sexual states with special reference to *Typha* 189
RUSBY, HENRY HURD Additions to the genus *Lycianthes* (Dunal) Hassler .. 209
BLAKE, SIDNEY FAY. Bertoloni's Guatemalan Asteraceae 215
HARPER, ROBERT ALMER. Morphogenesis in *Dictyostelium* (PLATES 6–8) ... 229
STOUT, ARLOW BURDETTE. The capsules, seed, and seedlings of the tiger lily, *Lilium tigrinum* 269
CHRYSLER, MINTIN ASBURY. Abnormalities in *Botrychium* and certain other ferns (PLATE 9) 279
GLEASON, HENRY ALLAN. Studies on the flora of northern South America —IX 289
RUSBY, HENRY HURD. Additions to the genus *Lycianthes*—A correction 302
FERGUSON, WILLIAM CASHMAN. Contributions to the flora of Long Island, New York—Fourth paper 303
KARLING, JOHN SIDNEY. Nuclear and cell division in Nitella and Chara (PLATES 10–13) 319
WEATHERWAX, PAUL. Persistence of the antipodal tissue in the development of the seed of maize 381
WALLACE, RAYMOND HAROLD. The production of intumescences upon apple twigs by ethylene gas (PLATES 14, 15) 385
SCOTT, FLORA MURRAY. Notes on the flora of the Miocene of the Tesla region, California (PLATE 16) 403
HEIN, ILLO. Changes in plastids in variegated plants (PLATE 17) 411
LUTMAN, BENJAMIN FRANKLIN. Respiration of potato tubers after injury .. 429
BRITTON, NATHANIEL LORD. Studies of West Indian plants—XIII 457

STASON, MARGARET. The Marsileas of the western United States..... 473
WODEHOUSE, ROGER PHILIP. Pollen grain morphology in the classification of the Anthemideae..... 479
GOLDSTEIN, BESSIE. A cytological study of the leaves and growing points of healthy and mosaic diseased tobacco plants (PLATES 18–29)..... 499
BLAKE, SIDNEY FAY. The identity of 'cuspa' (Conoria ? Cuspa H.B.K.).... 601
TRELEASE, SAM FARLOW, and HELEN M. TRELEASE. Relation of temperature to the physiological values of salt solutions as indicated by growth of wheat plants..... 605
LIVINGSTON, BURTON EDWARD. The present crisis in plant physiology..... 623
INDEX TO AMERICAN BOTANICAL LITERATURE, 37, 119, 171, 219, 309, 419, 487, 611, 648
INDEX TO VOLUME 53..... 665

Dates of Publication

No. 1, for January	Pages	1–58	Issued February	6, 1926
No. 2, for February	"	59–128	" February	27, 1926
No. 3, for March	"	129–182	" April	1, 1926
No. 4, for April	"	183–228	" April	22, 1926
No. 5, for May	"	229–318	" June	3, 1926
No. 6, for June	"	319–428	" July	10, 1926
No. 7, for October	"	429–498	" October	30, 1926
No. 8, for November	"	499–622	" December	29, 1926
No. 9, for December	"	623–671	" January	12, 1927

Vol. 53 No. 1

BULLETIN

OF THE

TORREY BOTANICAL CLUB

JANUARY 1926

An ecological study of certain ferns: Pellaea atropurpurea (L.) Link and Pellaea glabella Mettenius[1]

F. L. Pickett and Mildred E. Manuel

(with four figures)

Following similar work with other xerophytic ferns, and in conjunction with morphological studies of the two species of *Pellaea* here considered, an experimental study of certain adaptive characters has been made. These two species of ferns are generally well known as inhabitants of locations which are, at least in some seasons, subject to severe drought and other desiccating agencies. Various suggestions have been made at times in possible explanations of the ability of these ferns to withstand difficult growth conditions. These have been summarized by Miss Hayes[2] and need not be reviewed here. Up to this time, however, no experimental work seems to have been done touching the importance of the gametophyte generation in this relation.

The studies reported here were made with cultures of *P. atropurpurea* and *P. glabella* grown from spores collected in Monroe County, Indiana, in 1923, upon soil taken from the same locality. The prothallia were allowed to develop to maturity through a period of 15 to 20 weeks and then were subjected to various desiccating conditions. The results are given in brief form below.

A. Cultures were allowed to become dry in the greenhouse where the atmosphere showed about 20 per cent moisture.

On Jan. 19, 1924, cultures in the greenhouse were allowed to become air dry, and remained in that condition up to May 26, (124 days) when small portions were tested and showed nearly

[1] Contribution No. 4 from the Department of Botany of the State College of Washington.

[2] D. W. Hayes. Some studies of apogamy in *Pellaea atropurpurea* (L.) Link. Trans. Am. Micro. Soc. **43**: 119–135. July, 1924.

[The Bulletin for December (**52**: 491–553) was issued 6 January 1926.]

all plants living. After thorough wetting on this date these cultures were allowed to dry again and were placed in a cool, dry cupboard on June 5, where they remained untouched up to October 25 (142 days). These cultures had been exposed to dry air, and had received no water supply through this period of 142 days, and when they were watered showed more than half of the plants living. The other cultures were allowed to remain dry in the greenhouse from Oct. 25, 1924 to March 24, 1925 (150 days) and when watered showed fully three-fourths of the plants living. One of these cultures had been wholly dry since June 5, a total period of nine months and twenty days. The plants in these cultures were mature, many showing sporophytes with two or more leaves. The ability to survive natural drought conditions is seemingly the same for both prothallia and sporophytes.

B. Plants with a thin layer of attached soil which had been allowed to dry as in A, were placed in closed desiccators over anhydrous calcium chloride.

Portions of cultures which had been dry in the greenhouse since Jan. 19, 1924, were on May 26 placed in large closed desiccators. On Feb. 24, 1925, parts of this material were put under conditions for recovery with the result that a few prothallia of *P. atropurpurea* and many of *P. glabella* showed survival of cell masses sufficient for regeneration as noted later. The ability to survive these extreme conditions seems in no way connected with size or stage of development of prothallia; the smallest as well as large, embryo-bearing prothallia survived in equal numbers. The sporophytes, however, show higher percentage of survival than the prothallia.

At this time, Feb. 24, 1925, portions of the cultures, soil and plants, were removed from the desiccators, weighed, and after drying in an oven for five hours at a temperature of from 90° to 110° C., they were weighed again. The loss of weight was as follows:

For *P. atropurpurea* .00043 gm. per gm. or .043% of material weighed.

For *P. glabella* .00058 gm. per gm. or .058% of material weighed.

No explanation can be offered for the difference in loss by the two samples, unless there was a difference in the relative

amount of plant and soil materials in the two. In any case the amount of water, suggested by the slight loss indicated, is so far below that usually found in living plant tissues, or in soil where living plants are found, as to be worthy of note.

How long these fern prothallia and young sporophytes may be subjected to such extreme conditions and survive is still a question. A final test is being completed as this report is being written, Aug. 30, 1925. The portions of cultures placed in the desiccators on May 26, 1924, after being dry in the greenhouse for 138 days, were put under conditions for growth on July 28, 1925, a total of 18½ months with results as follows. After the plants and soil had been moistened most of the plants soon took on the dark color characteristic of dead tissue; but in a few plants small areas of tissue retained the bright green color of living plants. Now, one month after growth conditions had been provided, small masses of cells, evidently secondary prothallia, have appeared as outgrowths from these green areas.

For the benefit of those who may be interested somewhat in the technique of this work, the following details should perhaps be given. The fern room in the greenhouse where this work has been carried on has a south exposure. It is used entirely for this and similar drought experiments. Through the winter months its temperature is maintained at very nearly 21° C. (70° F.), with rare drops to 10° C. and rises to 27° C. In summer the ventilators are opened, but the temperature occasionally reaches 35° C. The average humidity is somewhat below 20 percent except during periods of actual rain or fog.

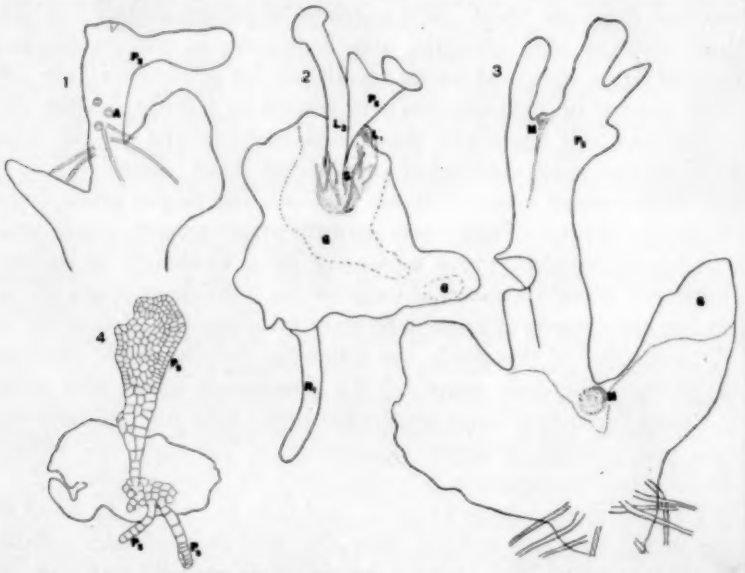
In determining whether or not plants are alive after periods of desiccation, the soil has been moistened, without flooding the plants; and observations made over such period, from two to five weeks, as needed to see *actual growth* before a report of "living plants" has been made.

As described elsewhere, these two ferns are wholly apogamous, showing no evidence of archegonial growth, but producing sporophytes through the increased activity and differentiation of masses of prothallial cells. The production of embryos seems not hindered by the desiccation experiments described. In many cases the appearance of embryo sporophytes has been the first sure sign of growth of surviving plants. Normal antheridia are produced frequently, and the formation within these of

spermatozoids, that may be extruded and then swim about freely in water within a few days after the plants have been returned to growth conditions, is, of course, evidence of life.

PROTHALLIAL PROLIFERATION

Old prothallia of *P. atropurpurea* show a tendency to produce secondary prothallia through proliferation. Marginal pro-



FIGS. 1–4. Prothallial proliferation: FIGS. 1–3, *Pellaea atropurpurea;* FIG. 4, *P. glabella*. Of special interest are the antheridia, A, on a secondary prothallium, Ps, in FIG. 1, the secondary prothallium produced after an embryo has started in FIG. 2, the beginning of an embryo on a secondary prothallium in FIG. 3, and the beginning of several prothallia from a small growing area in FIG. 4. All × 8. G, growing area; L, leaf; R, root; M, very young embryo; Ps, secondary prothallium; S, stem.

jections showing broadened apex and narrow base similar to normal prothallia are produced either from cells near the meristematic group at the base of the sinus or from other isolated marginal groups (FIGS. 1, 2, 3). Examination of a culture that had come into growth again after a long period of desiccation showed, together with many apogamous embryos, numerous secondary prothallia as just described. In this culture, however, this proliferation was nearly wholly connected with the meristematic tissue at the base of the sinus. In most cases these ferns

show such proliferation from tissue near the base of the sinus rather than from many marginal groups, as in *Camptosorus rhizophyllus*.[3]

Similar activity has been observed in prothallia of *P. glabella*, although the origin of secondary prothallia is different. Prothallia, which had been subjected to extreme desiccation, have in some cases shown only small areas of living cells after being returned to growing conditions. From these small living areas, miscellaneously scattered over the prothallium, new growth has produced secondary prothallia similar to those noted above (FIG. 4).

That these proliferations should be considered as true secondary prothallia is shown by the fact that they have been observed with antheridia as on other prothallia, and with apogamous embryos (FIG. 3).

Three items in history of the gametophyte of these ferns seem to have direct bearing upon their distribution: the ability to survive extreme drought, the power of renewed growth shown by the production of secondary prothallia, and the production of sporophytes apogamously.

The seasonal development may be given as follows:—

Fertile fronds appear in March or April and show mature spores by the first of July. When the atmosphere is dry the sporangia and spores are closely inclosed by the inrolling of the marginal false indusium. In moist periods the spores are freed, and come in contact with the nearby soil or cliff face. If the moisture persists for several days, the spores germinate. Alternate periods of abundant moisture and of drought, such as are common throughout the ranges of these ferns through the late summer, merely serve to arrest the growth of the prothallia. Free from the need of water as an aid in bringing about fertilization, when they have reached a proper stage of maturity, the prothallia produce embryo sporophytes apogamously, and these in three or four years produce spores.

PULLMAN, WASHINGTON

[3] Pickett, F. L. Some ecological adaptations of certain fern prothallia *Camptosorus rhizophyllus* Link., *Asplenium platyneuron* Oakes. Am. Jour. Bot. **1**: 477–498. *f. 1–19 + pl. 49, 50.* 1914.

The individualistic concept of the plant association*

H. A. Gleason

The continued activity of European ecologists, and to a somewhat smaller extent of American ecologists as well, in discussing the fundamental nature, structure, and classification of plant associations, and their apparently chronic inability to come to any general agreement on these matters, make it evident that the last word has not yet been said on the subject. Indeed, the constant disagreement of ecologists, the readiness with which flaws are found by one in the proposals of another, and the wide range of opinions which have been ably presented by careful observers, lead one to the suspicion that possibly many of them are somewhat mistaken in their concepts, or are attacking the problem from the wrong angle.

It is not proposed to cite any of the extensive recent literature on these general subjects, since it is well known to all working ecologists. Neither is it necessary to single out particular contributions for special criticism, nor to point out what may appear to us as errors in methods or conclusions.

It is a fact, as Dr. W. S. Cooper has brought out so clearly in a manuscript which he has allowed me to read, and which will doubtless be in print before this, that the tendency of the human species is to crystallize and to classify his knowledge; to arrange it in pigeon-holes, if I may borrow Dr. Cooper's metaphor. As accumulation of knowledge continues, we eventually find facts that will not fit properly into any established pigeon-hole. This should at once be the sign that possibly our original arrangement of pigeon-holes was insufficient and should lead us to a careful examination of our accumulated data. Then we may conclude that we would better demolish our whole system of arrangement and classification and start anew with hope of better success.

Is it not possible that the study of synecology suffers at the present time from this sort of trouble? Is it not conceivable that, as the study of plant associations has progressed from its originally simple condition into its present highly organized and complex state, we have attempted to arrange all our facts in ac-

* Contributions from The New York Botanical Garden, No. 279.

cordance with older ideas, and have come as a result into a tangle of conflicting ideas and theories?

No one can doubt for a moment that there is a solid basis of fact on which to build our study of synecology, or that the study is well worth building. It is the duty of the botanist to translate into intelligible words the various phenomena of plant life, and there are few phenomena more apparent than those of their spatial relations. Plant associations exist; we can walk over them, we can measure their extent, we can describe their structure in terms of their component species, we can correlate them with their environment, we can frequently discover their past history and make inferences about their future. For more than a century a general progress in these features of synecology can be traced.

It has been, and still is, the duty of the plant ecologist to furnish clear and accurate descriptions of these plant communities, so that by them the nature of the world's vegetation may be understood. Whether such a description places its emphasis chiefly on the general appearance of the association, on a list of its component species, on its broader successional relations, or on its gross environment, or whether it enters into far greater detail by use of the quadrat method, statistical analysis,[1] or exact environometry, it nevertheless contributes in every case to the advancement of our understanding of each association in detail and of vegetation in all its aspects in general.

It is only natural that we should tend to depart from the various conclusions which we have reached by direct observation or experiment, and to attempt other more general deductions as well. So we invent special terms and methods for indicating the differences between associations and the variation of the plant life within a single community. We draw conclusions for ourselves, and attempt to lay down rules for others as to ways and means of defining single associations, by character species, by statistical studies, by environmental relations, or by successional history. We attempt to classify associations, as individual

[1] Pavillard has cast serious doubt on the efficiency of the statistical method in answering questions of synecology. His argument, based solely on European conditions, needs of course no reply from America, but it may properly be pointed out that the intimate knowledge of vegetational structure obtained in this way may easily lead to a much fuller appreciation of synecological structure, entirely aside from any merits of the actual statistical results.

examples of vegetation, into broader groups, again basing our methods on various observable features and arriving accordingly at various results. We even enter the domain of philosophy, and speculate on the fundamental nature of the association, regard it as the basic unit of vegetation, call it an organism, and compare different areas of the same sort of vegetation to a species.

The numerous conclusions in synecology which depend directly upon observation or experiment are in the vast majority of cases entirely dependable. Ecologists are trained to be accurate in their observations, and it is highly improbable that any have erred purposely in order to substantiate a conclusion not entirely supported by facts. But our various theories on the fundamental nature, definition, and classification of associations extend largely beyond the bounds of experiment and observation and represent merely abstract extrapolations of the ecologist's mind. They are not based on a pure and rigid logic, and suffer regularly from the vagaries and errors of human reason. A geneticist can base a whole system of evolution on his observations of a single species: ecologists are certainly equally gifted with imagination, and their theories are prone to surpass by far the extent warranted by observation.

Let us then throw aside for the moment all our pre-conceived ideas as to the definition, fundamental nature, structure, and classification of plant associations, and examine step by step some of the various facts pertinent to the subject which we actually know. It will not be necessary to illustrate them by reference to definite vegetational conditions, although a few instances will be cited merely to make our meaning clear. Other illustrations will doubtless occur to every reader from his own field experience.

We all readily grant that there are areas of vegetation, having a measurable extent, in each of which there is a high degree of structural uniformity throughout, so that any two small portions of one of them look reasonably alike. Such an area is a plant association, but different ecologists may disagree on a number of matters connected with such an apparently simple condition. More careful examination of one of these areas, especially when conducted by some statistical method, will show that the uniformity is only a matter of degree, and that two sample quadrats with precisely the same structure can scarcely be discovered.

Consequently an area of vegetation which one ecologist regards as a single association may by another be considered as a mosaic or mixture of several, depending on their individual differences in definition. Some of these variations in structure (if one takes the broader view of the association) or smaller associations (if one prefers the narrower view) may be correlated with differences in the environment. For example, the lichens on a tree-trunk enjoy a different environment from the adjacent herbs growing in the forest floor. A prostrate decaying log is covered with herbs which differ from the ground flora in species or in relative numbers of individuals of each species. A shallow depression in the forest, occupied by the same species of trees as the surroundings, may support several species of moisture-loving herbs in the lower stratum of vegetation. In other cases, the variations in vegetational structure may show no relation whatever to the environment, as in the case of a dense patch of some species which spreads by rhizomes and accordingly comes to dominate its own small area. The essential point is that precise structural uniformity[2] of vegetation does not exist, and that we have no general agreement of opinion as to how much variation may be permitted within the scope of a single association.

In our attempts to define the limits of the association, we have but two actually observable features which may be used as a basis, the environment and the vegetation. Logically enough, most ecologists prefer the latter, and have developed a system based on character-species. In northern latitudes, and particularly in glaciated regions, where most of this work has been done, there is a wide diversity in environment and a comparatively limited number of species in the flora. A single association is therefore occupied by few species, with large numbers of individuals of each, and it has not been difficult to select from most associations a set of species which are not only fairly common and abundant, but which are strictly limited to the one association. But in many parts of the tropics, where diversity of environment has been reduced to a minimum by the practical completion of most physiographic processes and by the long-continued cumulation of plant reactions, and where the flora is

[2] It has often occurred to the writer that much of the structural variation in an association would disappear if those taxonomic units which have the same vegetational form and behavior could be considered as a single ecological unit.

extraordinarily rich in species, such a procedure is impracticable or even impossible. Where a single hectare may contain a hundred species of trees, not one of which can be found in an adjacent hectare, where a hundred quadrats may never exhibit the same herbaceous species twice, it is obvious that the method of characteristic species is difficult or impracticable.

It is also apparent that different areas of what are generally called the same association do not always have precisely the same environment. A grove of *Pinus Strobus* on soil formed from decomposed rocks in the eastern states, a second on the loose glacial sands of northern Michigan, and a third on the sandstone cliffs of northern Illinois are certainly subject to different environmental conditions of soil. An association of prairie grass in Illinois and another in Nebraska undoubtedly have considerable differences in rainfall and available water. A cypress swamp in Indiana has a different temperature environment from one in Florida.

Two environments which are identical in regard to physiography and climate may be occupied by entirely different associations. It is perfectly possible to duplicate environments in the Andes of southern Chile and in the Cascade Mountains of Oregon, yet the plant life is entirely different. Duplicate environments may be found in the deserts of Australia and of Arizona, and again have an entirely different assemblage of species. Alpine summits have essentially the same environment at equal altitudes and latitudes throughout the world, apart from local variations in the component rock, and again have different floras. It seems apparent, then, that environment can not be used as a means of defining associations with any better success than the vegetation.

At the margin of an association, it comes in contact with another, and there is a transition line or belt between them. In many instances, particularly where there is an abrupt change in the environment, this transition line is very narrow and sharply defined, so that a single step may sometimes be sufficient to take the observer from one into the other. In other places, especially where there is a very gradual transition in the environment, there is a correspondingly wide transition in the vegetation. Examples of the latter condition are easily found in any arid mountain region. The oak forests of the southern Coast Range

in California in many places descend upon the grass-covered foothills by a wide transition zone in which the trees become very gradually fewer and farther apart until they ultimately disappear completely. In Utah, it may be miles from the association of desert shrubs on the lower elevations across a mixture of shrubs and juniper before the pure stands of juniper are reached on the higher altitudes. It is obvious, therefore, that it is not always possible to define with accuracy the geographical boundaries of an association and that actual mixtures of associations occur.

Such transition zones, whether broad or narrow, are usually populated by species of the two associations concerned, but instances are not lacking of situations in which a number of species seem to colonize in the transition zone more freely than in either of the contiguous associations. Such is the case along the contact between prairie and forest, where many species of this type occur, probably because their optimum light requirements are better satisfied in the thin shade of the forest border than in the full sun of the prairie or the dense shade of the forest. Measured by component species such a transition zone rises almost to the dignity of an independent association.

Species of plants usually associated by an ecologist with a particular plant community are frequently found within many other types of vegetation. A single boulder, partly exposed above the ground at the foot of the Rocky Mountains in Colorado, in the short-grass prairie association, may be marked by a single plant of the mountain shrub *Cercocarpus*. In northern Michigan, scattered plants of the moisture-loving *Viburnum cassinoides* occur in the xerophytic upland thickets of birch and aspen. Every ecologist has seen these fragmentary associations, or instances of sporadic distribution, but they are generally passed by as negligible exceptions to what is considered a general rule.

There are always variations in vegetational structure from year to year within every plant association. This is exclusive of mere periodic variations from season to season, or aspects, caused by the periodicity of the component species. Slight differences in temperature or rainfall or other environmental factors may cause certain species to increase or decrease conspicuously in number of individuals, or others to vary in their vigor or luxuriance. Coville describes, in this connection, the remarkable variation in size of an *Amaranthus* in the Death Valley, which was

three meters high in a year of abundant rainfall, and its progeny only a decimeter high in the following year of drought.

The duration of an association is in general limited. Sooner or later each plant community gives way to a different type of vegetation, constituting the phenomenon known as succession. The existence of an association may be short or long, just as its superficial extent may be great or small. And just as it is often difficult and sometimes impossible to locate satisfactorily the boundaries of an association in space, so is it frequently impossible to distinguish accurately the beginning or the end of an association in time. It is only at the center of the association, both geographical and historical, that its distinctive character is easily recognizable. Fortunately for ecology, it commonly happens that associations of long duration are also wide in extent. But there are others, mostly following fires or other unusual disturbances of the original vegetation, whose existence is so limited, whose disappearance follows so closely on their origin, that they scarcely seem to reach at any time a condition of stable equilibrium, and their treatment in any ecological study is difficult. The short-lived communities bear somewhat the same relation to time-distribution as the fragmentary associations bear to space-distribution. If our ecological terminology were not already nearly saturated, they might be termed ephemeral associations.

Now, when all these features of the plant community are considered, it seems that we are treading upon rather dangerous ground when we define an association as an area of uniform vegetation, or, in fact, when we attempt any definition of it. A community is frequently so heterogeneous as to lead observers to conflicting ideas as to its associational identity, its boundaries may be so poorly marked that they can not be located with any degree of accuracy, its origin and disappearance may be so gradual that its time-boundaries can not be located; small fragments of associations with only a small proportion of their normal components of species are often observed; the duration of a community may be so short that it fails to show a period of equilibrium in its structure.

A great deal has been said of the repetition of associations on different stations over a considerable area. This phenomenon is striking, indeed, and upon it depend our numerous attempts to

classify associations into larger groups. In a region of numerous glacial lakes, as in parts of our northeastern states, we find lake after lake surrounded by apparently the same communities, each of them with essentially the same array of species in about the same numerical proportions. If an ecologist had crossed Illinois from east to west prior to civilization, he would have found each stream bordered by the same types of forest, various species of oaks and hickories on the upland, and ash, maple, and sycamore in the alluvial soil nearer the water. But even this idea, if carried too far afield, is found to be far from universal. If our study of glacial lakes is extended to a long series, stretching from Maine past the Great Lakes and far west into Saskatchewan, a very gradual but nevertheless apparent geographical diversity becomes evident, so that the westernmost and easternmost members of the series, while still containing some species in common, are so different floristically that they would scarcely be regarded as members of the same association. If one examines the forests of the alluvial floodplain of the Mississippi River in southeastern Minnesota, that of one mile seems to be precisely like that of the next. As the observer continues his studies farther down stream, additional species very gradually appear, and many of the original ones likewise very gradually disappear. In any short distance these differences are so minute as to be negligible, but they are cumulative and result in an almost complete change in the flora after several hundred miles.

No ecologist would refer the alluvial forests of the upper and lower Mississippi to the same associations, yet there is no place along their whole range where one can logically mark the boundary between them. One association merges gradually into the next without any apparent transition zone. Nor is it necessary to extend our observations over such a wide area to discover this spatial variation in ecological structure. I believe no one has ever doubted that the beech-maple forest of northern Michigan constitutes a single association-type. Yet every detached area of it exhibits easily discoverable floristic peculiarities, and even adjacent square miles of a single area differ notably among themselves, not in the broader features, to be sure, but in the details of floristic composition which a simple statistical analysis brings out. In other words, the local variation in

structure of any association merges gradually into the broader geographical variation of the association-type.

This diversity in space is commonly overlooked by ecologists, most of whom of necessity limit their work to a comparatively small area, not extensive enough to indicate that the small observed floristic differences between associations may be of much significance or that this wide geographical variation is actually in operation. Yet it makes difficult the exact definition of any association-type, except as developed in a restricted locality, renders it almost impossible to select for study a typical or average example of a type, and in general introduces complexities into any attempt to classify plant associations.

What have we now as a basis for consideration in our attempts to define and classify associations? In the northeastern states, we can find many sharply marked communities, capable of fairly exact location on a map. But not all of that region can be thus divided into associations, and there are other regions where associations, if they exist at all in the ordinary sense of the word, are so vaguely defined that one does not know where their limits lie and can locate only arbitrary geographic boundaries. We know that associations vary internally from year to year, so that any definition we may make of a particular community, based on the most careful analysis of the vegetation, may be wrong next year. We know that the origin and disappearance of some are rapid, of others slow, but we do not always know whether a particular type of vegetation is really an association in itself or represents merely the slow transition stage between two others. We know that no two areas, supposed to represent the same association-type, are exactly the same, and we do not know which one to accept as typical and which to assume as showing the effects of geographical variation. We find fragmentary associations, and usually have no solid basis for deciding whether they are mere accidental intruders or embryonic stages in a developing association which may become typical after a lapse of years. We find variation of environment within the association, similar associations occupying different environments, and different associations in the same environment. It is small wonder that there is conflict and confusion in the definition and classification of plant communities. Surely our belief in the integrity of the association and the sanc-

tity of the association-concept must be severely shaken. Are we not justified in coming to the general conclusion, far removed from the prevailing opinion, that an association is not an organism, scarcely even a vegetational unit, but merely a *coincidence?*

This question has been raised on what might well be termed negative evidence. It has been shown that the extraordinary variability of the areas termed associations interferes seriously with their description, their delimitation, and their classification. Can we find some more positive evidence to substantiate the same idea? To do this, we must revert to the individualistic concept of the development of plant communities, as suggested by me in an earlier paper.[3]

As a basis for the presentation of the individualistic concept of the plant association, the reader may assume for illustration any plant of his acquaintance, growing in any sort of environment or location. During its life it produces one or more crops of seeds, either unaided or with the assistance of another plant in pollination. These seeds are endowed with some means of migration by which they ultimately come to rest on the ground at a distance from the parent plant. Some seeds are poorly fitted for migration and normally travel but a short distance; others are better adapted and may cover a long distance before coming to rest. All species of plants occasionally profit by accidental means of dispersal, by means of which they traverse

[3] I may frankly admit that my earlier ideas of the plant association were by no means similar to the concept here discussed. Ideas are subject to modification and change as additional facts accumulate and the observer's geographical experience is broadened. An inkling of the effect of migration on the plant community appeared as early as 1903 and 1904 (Bull. Illinois State Lab. Nat. Hist. **7:** 189.) My field work of 1908 covered a single general type of environment over a wide area, and was responsible for still more of my present opinions (Bull. Illinois State Lab. Nat. Hist. **9:** 35–42). Thus we find such statements as the following: "No two areas of vegetation are exactly similar, either in species, the relative numbers of individuals of each, or their spatial arrangement" (l. c. 37), and again: "The more widely the different areas of an association are separated, the greater are the floral discrepancies. . . . Many of these are the results of selective migration from neighboring associations, so that a variation in the general nature of the vegetation of an area affects the specific structure of each association" (l. c. 41). Still further experience led to my summary of vegetational structure in 1917 (Bull. Torrey Club **44:** 463–481), and the careful quantitative study of certain associations from 1911 to 1923 produced the unexpected information that the distribution of species and individuals within a community followed the mathematical laws of probability and chance (Ecology **6:** 66–74).

distances far in excess of their average journey. Sometimes these longer trips may be of such a nature that the seed is rendered incapable of germination, as in dispersal by currents of salt water, but in many cases they will remain viable. A majority of the seeds reach their final stopping-point not far from the parent, comparatively speaking, and only progressively smaller numbers of them are distributed over a wider circle. The actual number of seeds produced is generally large, or a small number may be compensated by repeated crops in successive years. The actual methods of dispersal are too well known to demand attention at this place.

For the growth of these seeds a certain environment is necessary. They will germinate between folds of paper, if given the proper conditions of light, moisture, oxygen, and heat. They will germinate in the soil if they find a favorable environment, irrespective of its geographical location or the nature of the surrounding vegetation. Herein we find the *crux* of the question. The plant individual shows no physiological response to geographical location or to surrounding vegetation *per se*, but is limited to a particular complex of environmental conditions, which may be correlated with location, or controlled, modified, or supplied by vegetation. If a viable seed migrates to a suitable environment, it germinates. If the environment remains favorable, the young plants will come to maturity, bear seeds in their turn, and serve as further centers of distribution for the species. Seeds which fall in unfavorable environments do not germinate, eventually lose their viability and their history closes.

As a result of this constant seed-migration, every plant association is regularly sowed with seeds of numerous extra-limital species, as well as with seeds of its own normal plant population. The latter will be in the majority, since most seeds fall close to the parent plant. The seeds of extra-limital species will be most numerous near the margin of the association, where they have the advantage of proximity to their parent plants. Smaller numbers of fewer species will be scattered throughout the association, the actual number depending on the distance to be covered, and the species represented depending on their means of migration, including the various accidents of dispersal. This thesis needs no argument in its support. The practical univer-

sality of seed dispersal is known to every botanist as a matter of common experience.

An exact physiological analysis of the various species in a single association would certainly show that their optimal environments are not precisely identical, but cover a considerable range. At the same time, the available environment tends to fluctuate from year to year with the annual variations of climate and with the accumulated reactionary effects of the plant population. The average environment may be near the optimum for some species, near the physiological limit of others, and for a third group may occasionally lie completely outside the necessary requirements. In the latter case there will result a group of evanescent species, variable in number and kind, depending on the accidents of dispersal, which may occasionally be found in the association and then be missing for a period of years. This has already been suggested by the writer as a probable explanation of certain phenomena of plant life on mountains, and was also clearly demonstrated by Dodds, Ramaley, and Robbins in their studies of vegetation in Colorado. In the first and second cases, the effect of environmental variation toward or away from the optimum will be reflected in the number of individual plants and their general luxuriance. On the other hand, those species which are limited to a single type of plant association must find in that and in that only the environmental conditions necessary to their life, since they have certainly dispersed their seeds many times into other communities, or else be so far removed from other associations of similar environment that their migration thence is impossible.

Nor are plants in general, apart from these few restricted species, limited to a very narrow range of environmental demands. Probably those species which are parasitic or which require the presence of a certain soil-organism for their successful germination and growth are the most highly restricted, but for the same reason they are generally among the rarest and most localized in their range. Most plants can and do endure a considerable range in their environment.

With the continuance of this dispersal of seeds over a period of years, every plant association tends to contain every species of the vicinity which can grow in the available environment. Once a species is established, even by a single seed-bearing plant,

its further spread through the association is hastened, since it no longer needs to depend on a long or accidental migration, and this spread is continued until the species is eventually distributed throughout the area of the association. In general, it may be considered that, other things being equal, those species of wide extent through an association are those of early introduction which have had ample t me to complete their spread, while those of localized or sporadic distribution are the recent arrivals which have not yet become completely established.

This individualistic standpoint therefore furnishes us with an explanation of several of the difficulties which confront us in our attempts to diagnose or classify associations. Heterogeneity in the structure of an association may be explained by the accidents of seed dispersal and by the lack of time for complete establishment. Minor differences between neighboring associations of the same general type may be due to irregularities in immigration and minor variations in environment. Geographical variation in the floristics of an association depends not alone on the geographical variation of the environment, but also on differences in the surrounding floras, which furnish the immigrants into the association. Two widely distant but essentially similar environments have different plant associations because of the completely different plant population from which immigrants may be drawn.

But it must be noted that an appreciation of these conditions still leaves us unable to recognize any one example of an association-type as the normal or typical. Every association of the same general type has come into existence and had its structure determined by the same sort of causes; each is independent of the other, except as it has derived immigrants from the other; each is fully entitled to be recognized as an association and there is no more reason for regarding one as typical than another. Neither are we given any method for the classification of associations into any broader groups.

Similar conditions obtain for the development of vegetation in a new habitat. Let us assume a dozen miniature dunes, heaped up behind fragments of driftwood on the shore of Lake Michigan. Seeds are heaped up with the sand by the same propelling power of the wind, but they are never very numerous and usually of various species. Some of them germinate, and the dozen embryonic dunes may thenceforth be held by as many different

species of plants. Originally the environment of the dunes was identical and their floristic difference is due solely to the chances of seed dispersal. As soon as the plants have developed, the environment is subject to the modifying action of the plant, and small differences between the different dunes appear. These are so slight that they are evidenced more by the size and shape of the dune than by its flora, but nevertheless they exist. Additional species gradually appear, but that is a slow process, involving not only the chance migration of the seed to the exact spot but also its covering upon arrival. It is not strange that individuals are few and that species vary from one dune to another, and it is not until much later in the history of each dune, when the ground cover has become so dense that it affects conditions of light and soil moisture, and when decaying vegetable matter is adding humus to the sand in appreciable quantities, that a true selective action of the environment becomes possible. After that time permanent differences in the vegetation may appear, but the early stages of dune communities are due to chance alone. Under such circumstances, how can an ecologist select character species or how can he define the boundaries of an association? As a matter of fact, in such a location the association, in the ordinary sense of the term, scarcely exists.

Assume again a series of artificial excavations in an agricultural region, deep enough to catch and retain water for most or all of the summer, but considerably removed from the nearest areas of natural aquatic vegetation. Annually the surrounding fields have been ineffectively planted with seeds of *Typha* and other wind-distributed hydrophytes, and in some of the new pools *Typha* seeds germinate at once. Water-loving birds bring various species to other pools. Various sorts of accidents conspire to the planting of all of them. The result is that certain pools soon have a vegetation of *Typha latifolia*, others of *Typha angustifolia*, others of *Scirpus validus;* plants of *Iris versicolor* appear in one, of *Sagittaria* in another, of *Alisma* in a third, of *Juncus effusus* in a fourth. Only the chances of seed dispersal have determined the allocation of species to different pools, but in the course of three or four years each pool has a different appearance, although the environment, aside from the reaction of the various species, is precisely the same for each. Are we dealing here with several different associations, or with a single association, or with

merely embryonic stages of some future association? Under our view, these become merely academic questions, and any answer which may be suggested is equally academic.

But it must again be emphasized that these small areas of vegetation are component parts of the vegetative mantle of the land, and as such are fully worthy of description, of discussion, and of inquiry into the causes which have produced them and into their probable future. It must be emphasized that in citing the foregoing examples, the existence of associations or of successions is not denied, and that the purpose of the two paragraphs is to point out the fact that such communities introduce many difficulties into any attempt to define or classify association-types and successional series.

A plant association therefore, using the term in its ordinarily accepted meaning, represents the result of an environmental sorting of a population, but there are other communities which have existed such a short time that a reasonably large population has not yet been available for sorting.

Let us consider next the relation of migration and environmental selection to succession. We realize that all habitats are marked by continuous environmental fluctuation, accompanied or followed by a resulting vegetational fluctuation, but, in the common usage of the term, this is hardly to be regarded as an example of succession. But if the environmental change proceeds steadily and progressively in one direction, the vegetation ultimately shows a permanent change. Old species find it increasingly difficult or impossible to reproduce, as the environment approaches and finally passes their physiological demands. Some of the migrants find establishment progressively easier, as the environment passes the limit and approaches the optimum of their requirements. These are represented by more and more individuals, until they finally become the most conspicuous element of the association, and we say that a second stage of a successional series has been reached.

It has sometimes been assumed that the various stages in a successional series follow each other in a regular and fixed sequence, but that is frequently not the case. The next vegetation will depend entirely on the nature of the immigration which takes place in the particular period when environmental change reaches the critical stage. Who can predict the future

for any one of the little ponds considered above? In one, as the bottom silts up, the chance migration of willow seeds will produce a willow thicket, in a second a thicket of *Cephalanthus* may develop, while a third, which happens to get no shrubby immigrants, may be converted into a miniature meadow of *Calamagrostis canadensis*. A glance at the diagram of observed successions in the Beach Area, Illinois, as published by Gates, will show at once how extraordinarily complicated the matter may become, and how far vegetation may fail to follow simple, pre-supposed successional series.

It is a fact, of course, that adjacent vegetation, because of its mere proximity, has the best chance in migration, and it is equally true that in many cases the tendency is for an environment, during its process of change, to approximate the conditions of adjacent areas. Such an environmental change becomes effective at the margin of an association, and we have as a result the apparent advance of one association upon another, so that their present distribution in space portrays their succession in time. The conspicuousness of this phenomenon has probably been the cause of the undue emphasis laid on the idea of successional series. But even here the individualistic nature of succession is often apparent. Commonly the vegetation of the advancing edge differs from that of the older established portion of the association in the numerical proportion of individuals of the component species due to the sorting of immigrants by an environment which has not yet reached the optimum, and, when the rate of succession is very rapid, the pioneer species are frequently limited to those of the greatest mobility. It also happens that the change in environment may become effective throughout the whole area of the association simultaneously, or may begin somewhere near the center. In such cases the pioneers of the succeeding association are dependent on their high mobility or on accidental dispersal, as well as environmental selection.

It is well known that the duration of the different stages in succession varies greatly. Some are superseded in a very short time, others persist for long or even indefinite periods. This again introduces difficulties into any scheme for defining and classifying associations.

A forest of beech and maple in northern Michigan is lumbered, and as a result of exposure to light and wind most of the usual

herbaceous species also die. Brush fires sweep over the clearing and aid in the destruction of the original vegetation. Very soon the area grows up to a tangle of other herbaceous and shrubby species, notably *Epilobium angustifolium*, *Rubus strigosus*, and *Sambucus racemosa*. This persists but a few years before it is overtopped by saplings of the original hardwoods which eventually restore the forest. Is this early stage of fire-weeds and shrubs a distinct association or merely an embryonic phase of the forest? Since it has such a short duration, it is frequently regarded as the latter, but since it is caused by an entirely different type of environmental sorting and lacks most of the characteristic species of the forest, it might as well be called distinct. If it lasted for a long period of years it would certainly be called an association, and if all the forest near enough to provide seeds for immigration were lumbered, that might be the case. Again we are confronted with a purely arbitrary decision as to the associational identity of the vegetation.

Similarly, in the broad transition zone between the oak-covered mountains and the grass-covered foothills in the Coast Range of California, we are forced to deal arbitrarily in any matter of classification. Shall we call such a zone a mere transition, describe the forests above and the grasslands below and neglect the transition as a mere mixture? Or shall we regard it as a successional or time transition, evidencing the advance of the grasslands up the mountain or of the oaks down toward the foothills? If we choose the latter, we must decide whether the future trend of rainfall is to increase, thereby bringing the oaks to lower elevations, or to decrease, thereby encouraging the grasslands to grow at higher altitudes. If we adopt the former alternative, we either neglect or do a scientific injustice to a great strip of vegetation, in which numerous species are "associated" just as surely as in any recognized plant association.

The sole conclusion we can draw from all the foregoing considerations is that the vegetation of an area is merely the resultant of two factors, the fluctuating and fortuitous immigration of plants and an equally fluctuating and variable environment. As a result, there is no inherent reason why any two areas of the earth's surface should bear precisely the same vegetation, nor any reason for adhering to our old ideas of the definiteness and distinctness of plant associations. As a matter of fact, no

two areas of the earth's surface do bear precisely the same vegetation, except as a matter of chance, and that chance may be broken in another year by a continuance of the same variable migration and fluctuating environment which produced it. Again, experience has shown that it is impossible for ecologists to agree on the scope of the plant association or on the method of classifying plant communities. Furthermore, it seems that the vegetation of a region is not capable of complete segregation into definite communities, but that there is a considerable development of vegetational mixtures.

Why then should there be any representation at all of these characteristic areas of relatively similar vegetation which are generally recognized by plant ecologists under the name of associations, the existence of which is indisputable as shown by our field studies in many parts of the world, and whose frequent repetition in similar areas of the same general region has led us to attempt their classification into vegetational groups of superior rank?

It has been shown that vegetation is the resultant of migration and environmental selection. In any general region there is a large flora and it has furnished migrating seeds for all parts of the region alike. Every environment has therefore had, in general, similar material of species for the sorting process. Environments are determined principally by climate and soil, and are altered by climatic changes, physiographic processes, and reaction of the plant population. Essentially the same environments are repeated in the same region, their selective action upon the plant immigrants leads to an essentially similar flora in each, and a similar flora produces similar reactions. These conditions produce the well known phenomena of plant associations of recognizable extent and their repetition with great fidelity in many areas of the same region, but they also produce the variable vegetation of our sand dunes and small pools, the fragmentary associations of areas of small size, and the broad transition zones where different types of vegetation are mixed. Climatic changes are always slow, physiographic processes frequently reach stages where further change is greatly retarded, and the accumulated effects of plant reaction often reach a condition beyond which they have relatively little effect on plant life. All of these conspire to give to certain areas a comparatively uniform en-

vironment for a considerable period of time, during which continued migration of plants leads to a smoothing out of original vegetational differences and to the establishment of a relatively uniform and static vegetational structure. But other physiographic processes are rapid and soon develop an entirely different environment, and some plant reactions are rapid in their operation and profound in their effects. These lead to the short duration of some plant communities, to the development, through the prevention of complete migration by lack of sufficient time, of associations of few species and of different species in the same environment, and to mixtures of vegetation which seem to baffle all attempts to resolve them into distinct associations.

Under the usual concept, the plant association is an area of vegetation in which spatial extent, describable structure, and distinctness from other areas are the essential features. Under extensions of this concept it has been regarded as a unit of vegetation, signifying or implying that vegetation in general is composed of a multiplicity of such units, as an individual representation of a general group, bearing a general similarity to the relation of an individual to a species, or even as an organism, which is merely a more striking manner of expressing its unit nature and uniformity of structure. In every case spatial extent is an indispensable part of the definition. Under the individualistic concept, the fundamental idea is neither extent, unit character, permanence, nor definiteness of structure. It is rather the visible expression, through the juxtaposition of individuals, of the same or different species and either with or without mutual influence, of the result of causes in continuous operation. These primary causes, migration and environmental selection, operate independently on each area, no matter how small, and have no relation to the process on any other area. Nor are they related to the vegetation of any other area, except as the latter may serve as a source of migrants or control the environment of the former. The effect of these primary causes is therefore not to produce large areas of similar vegetation, but to determine the plant life on every minimum area. The recurrence of a similar juxtaposition over tracts of measurable extent, producing an association in the ordinary use of the term, is due to a similarity in the contributing causes over the whole area involved.

Where one or both of the primary causes changes abruptly, sharply delimited areas of vegetation ensue. Since such a condition is of common occurrence, the distinctness of associations is in many regions obvious, and has led first to the recognition of communities and later to their common acceptance as vegetational units. Where the variation of the causes is gradual, the apparent distinctness of associations is lost. The continuation in time of these primary causes unchanged produces associational stability, and the alteration of either or both leads to succession. If the nature and sequence of these changes are identical for all the associations of one general type (although they need not be synchronous), similar successions ensue, producing successional series. Climax vegetation represents a stage at which effective changes have ceased, although their resumption at any future time may again initiate a new series of successions.

In conclusion, it may be said that every species of plant is a law unto itself, the distribution of which in space depends upon its individual peculiarities of migration and environmental requirements. Its disseminules migrate everywhere, and grow wherever they find favorable conditions. The species disappears from areas where the environment is no longer endurable. It grows in company with any other species of similar environmental requirements, irrespective of their normal associational affiliations. The behavior of the plant offers in itself no reason at all for the segregation of definite communities. Plant associations, the most conspicuous illustration of the space relation of plants, depend solely on the coincidence of environmental selection and migration over an area of recognizable extent and usually for a time of considerable duration. A rigid definition of the scope or extent of the association is impossible, and a logical classification of associations into larger groups, or into successional series, has not yet been achieved.

The writer expresses his thanks to Dr. W. S. Cooper, Dr. Frank C. Gates, Major Barrington Moore, Mr. Norman Taylor, and Dr. A. G. Vestal for kindly criticism and suggestion during the preparation of this paper.

Notes on Tilia

W. W. Ashe

PUBESCENT MIDSUMMER SHOOTS

In the characterization of the tree of southwestern Louisiana described under the name *Tilia Cocksii* Dr. Sargent[1] calls attention to the unique feature whereby a glabrous or nearly glabrous spring shoot is terminated by pubescent of tomentose midsummer growth. This manner of development is not confined to this species but is apparently common to at least four other lindens and probably should be regarded as a group character. The tomentose midsummer growth is followed by a glabrous shoot the following spring. The result is a branchlet having alternate sections glabrous and tomentose or having a tomentose internode. It is desirable that collections of summer shoots be made of other southern lindens. It might seem to be designed as a means of protecting the tender midsummer growth which develops during a period of high temperature from injury by the heat. The other species so far noted having this character are *Tilia porracea* Ashe,[2] *T. leucocarpa* Ashe,[3] *T. floridana* Small,[4] and *T. creno-serrata* Sargent.[5] This is a character which divides the glabrous species of this genus, or the species with glabrous twigs, in the eastern United States into two sections.

Since the preceding paragraph was written, it has been possible to examine summer shoots of *Tilia venulosa* Sargent (Bot. Gaz. **66:** 426. 1918) on a tree which the writer has growing. The shoot is pubescent with long ascending straight hairs mixed with shorter fascicled hairs. Thus five species having glabrous spring shoots have pubescent summer shoots. It should be recorded here that summer shoots of *Tilia glabra* Vent. (Anales Hist. Nat. **2:** 62. 1800) from trees growing in Washington, D. C., are glabrous. *T. alabamensis* Ashe (Bull. Charleston Museum **14:** 31. 1918) and *T. australis* Small also have glabrous summer shoots.

[1] Bot. Gaz. **66:** 437. 1918.
[2] Charleston Museum Quart. **1:** 31. 1925.
[3] Bull. Charleston Museum **14:** 32. 1918.
[4] Fl. Southeastern United States 761. 1903.
[5] Bot. Gaz. **66:** 430. 1918.

TILIA MICHAUXII Nuttall

F. A. Michaux,[6] in volume three of his work on the trees of North America, described three species of *Tilia* in the following sequence: *Tilia americana*, *T. alba*, and *T. pubescens*. Of these the first and last were included in the Flora Boreali-Americana of André Michaux,[7] his father, the former under the name *T. canadensis* and the latter as *T. laxiflora*. *T. alba* was proposed as a new species, its description being supplemented by an excellent plate. In referring to the distribution and habitat of the proposed species, it is stated that "it is common in Pennsylvania, Maryland, and Virginia and in the states west of the Allegheny Mountains. This lime does not grow, like the preceding [i.e. *T. americana*], on uplands, nor among other trees in the forests; it is seldom seen elsewhere than on the banks of rivers" (translated). The distribution which is given and the habitat assigned seem to have been important in determining the conception of the tree which is described. The common linden throughout this region in the habitat given is the species which recent authors refer to *T. Michauxii* Nuttall. Its characters are well known: leaves of medium size, 7 to 10 cm. long, ovate, prevailingly cordate at base, short petiole, 3 to 4 cm. long, medium green above, pale grayish-green beneath with a close scattered stellate pubescence especially on leaves from the lower branches, or sometimes the leaves on upper part of tree white beneath with an extremely short, close, but never dense tomentum, flowers 6 to 7 mm. long, bract narrow, 1 to 2 cm. wide but often elongated, 10 to 12 cm. long.

Now *Tilia Michauxii* Nuttall[8] was based on *T. alba* Michaux fils, which name was invalid because of the earlier *T. alba* L. The description of *T. alba* Michx. f. (translated and only essential characters mentioned) is quite different from that just given: "The leaves are very large, oval or roundish, heart-shaped or very obliquely truncate at base, upper surface dark green, lower white with little tufts of reddish hairs in the axils of the principal veins. The flowers as well as the floral bracts are larger than those of any other linden which I know. The petals also are whiter and larger." A comparison with *T. americana*, the de-

[6] Hist. Arb. Am. **3**: 315. *pl. 2*. 1813.
[7] Fl. Bor. Am. **1**: 306. 1803.
[8] N. A. Sylva **1**: 92. 1842.

scription of which immediately precedes that of *T. alba* (and which might possibly include *T. neglecta* Spach), would indicate that the leaves, flowers, floral bracts, and petals were larger than those of that species. The flowers of *T. americana* and of *T. neglecta* are from 8 to 10 mm. long. Those of *T. alba* consequently must be larger. As figured they are about one-fourth larger, while the petioles are figured as 5 to 6 cm. long.

The only species in this general region to which the description of *T. alba* Michx. f. can apply is the Appalachian species which long passed under the name of *T. heterophylla*. It has the very large leaves described and the long petioles figured by Michaux for his *T. alba*, with the same shapes, cordate in the roundish form, very oblique in the oval, dark green above, always snowy white beneath with a close persistent tomentum and with minute reddish axillary tufts, the largest floral bracts of any eastern American species (often 18 cm. long and more than 3 cm. wide), the largest flowers (10 to 12 mm. long) with the whitest petals.

The description of *T. alba* Michx. f. clearly does not refer to *T. Michauxii* as currently interpreted and does not even include this *T. Michauxii*. It is evidently drawn exclusively from the large-leaved, large-flowered, large-bracted Appalachian species. André Michaux, the father of F. A. Michaux, between 1787 and 1796 made extensive collections of American plants and seeds which were sent to France. Many of these collections were made in the Appalachian region and in his Journal he particularly mentions collecting near the site where now is located the town of Highlands, North Carolina, a section where the large-flowered linden is common. Ventenat undoubtedly employed material from such cultivated plants introduced through Michaux and Fraser in preparing the plate which accompanies the description of his *T. heterophylla*.[9] Michaux fils probably drew upon such a living tree introduced by his father for this description and plate of his *T. alba;* or on the two trips he made to the United States in 1802 and 1806 preparatory to writing the "History," a tree of the large-flowered species may have been the one selected for comparison and description.

Tilia Michauxii is apparently distributed from near Highlands, Macon County, North Carolina, to Nashville, Tennessee,

[9] Mém. Inst. Sci. Paris 4[2]: 16. *pl. 5.* 1802.

and northward to Breathett County, Kentucky (W. W. A.), and Upshur County, West Virginia.

Its synonymy seems to be:

T. alba Michx. f. Hist. Arb. Am. **3:** 315. *pl. 2.* (not Linnaeus) 1813.

T. monticola Sargent, Bot. Gaz. **66:** 508. 1918.

T. heterophylla, at least in part, of many American authors.

TYPE OF TILIA HETEROPHYLLA VENTENAT

In reference to the type of *T. heterophylla* Vent., which it is believed Dr. Sargent[10] has established, it is significant that A. Michaux in his Journal refers to *Tilia* only in one place east of the Allegheny Mountains and south of Pennsylvania. This was under date of May 28, 1787, in South Carolina within 3 miles of Augusta, Ga. He leaves a blank after the single word "*Tilia*" in the Journal as if intending to fill in later with a description. Dr. Sargent cites near Augusta, Georgia, as a location for material which he regards as typical. This is possibly the source of the trees upon which Ventenat based his description. Material from several trees along Chauga River, 15 miles from Walhalla, South Carolina, clearly the same as the Walhalla trees (which Dr. Sargent regards as typical) conforms in the shape of the leaves to Ventenat's plate even more closely than do the Walhalla trees. None of the leaves of these trees are brownish tomentose beneath. This character, however, is not constant.

Tilia heterophylla tenera comb. nov.—*T. tenera* Ashe, Bull. Charleston Museum **13:** 27. 1917.—The next available name for the tree which has been called *T. heterophylla Michauxii* (Sargent, *op. cit.*, 506) seems to be *T. tenera*, which was based upon material from near the Deep River in Moore County, North Carolina.

Tilia lata sp. nov. A tree up to 20 m. high and 5 dm. in diameter or occasionally almost shrubby and bearing flowers and fruiting at a height of not more than 2.2 m. Twigs rather slender, 2 to 3 mm. thick, when mature dull chestnut brown, as are the obtuse winter buds, both covered with a usually thin grayish-brown, scurfy, fascicled pubescence, mostly persistent on the buds, sometimes deciduous on the twigs by midsummer. Leaves ovate or broadly ovate, ample, the blades 11 to 16 cm. long, 10 to 16 cm. wide, abruptly acuminate at apex, truncate or ob-

[10] Bot. Gaz. **66:** 504. 1918.

liquely cordate at base or sometimes nearly all leaves cordate, but lower invariably more cordate and symmetrical than upper, coarsely dentate with rounded or obtuse apiculate teeth, on unfolding a deep purple-bronze and pubescent above with fascicled hairs, when mature thick, dark green and glabrous above, white or bright silvery gray below with a rather close fascicled pubescence, the midrib covered with short fascicled scurfy pubescence, often mixed with long straight appressed hairs, leaves at the ends of twigs often tawny or brownish beneath; petiole short, 2 to 5 cm. long, slender, at first covered with scurfy grayish pubescence. Flowers 7 to 8 mm. long, appearing about the first week in June, in rather compact 10 to 20-flowered pubescent corymbs on slender tomentose pedicels; sepals ovate, acute, flesh colored, finely pubescent without, densely silky tomentose within or glabrous in the center; petals broadly lanceolate, contracted above the middle, the apex broad and rounded; staminodia oblong or elliptic, very broad and obtuse at apex, about two-thirds as long as petals; peduncle slender, pubescent, becoming free near the middle of the bract and sometimes extending beyond the bract, the free portion often soon glabrous; bract oblong or oblong-obovate, rounded at the broad apex, often narrow at base, the blade 8 to 12 cm. long, 2.5 to 4 cm. broad, thin, above glabrous or soon glabrous and often glaucescent, below yellowish and covered with very short fascicled pubescence, usually on a slender stalk which may be 4 cm. long, sometimes subsessile.

Type collected by the writer, May 1923, from near Sipsey Fork Bridge on the road from Addison to Houston, Alabama. Leaves on vigorous shoots sometimes 3-lobed or notched. This species is very common on the Brushy Fork of Sipsey River in Lawrence and Winston counties, Alabama, and is generally spread over the adjoining mountainous counties in the Sand Mountain region, growing particularly along streams, but occasionally on rocky hillsides well up the slopes. It is associated with *Tilia australis* Small, and blooms at the same time as that species. The proposed species differs from *T. heterophylla* Ventenat, in its larger flowers, very broad petals and staminodia, in its much shorter pubescence, in the large thin bracts, glabrous or glabrate above, and merely pubescent beneath, and in its earlier time of blooming.

Tilia eburnea lasioclada comb. nov.—*T. lasioclada* Sargent, Bot. Gaz. **66**: 502. 1918.—This differs from the type in having the twigs more or less densely clothed with straight, simple hairs. Typical *T. eburnea* Ashe has rather stout, glabrous

twigs and medium sized leaves obliquely cordate or truncate at base, silvery pubescent beneath with loose fascicled hairs or becoming glabrate with age. The floral bract both of the type and of the variety is soft pubescent beneath with long, simple, straight, white hairs. *T. eburnea* and its variety *lasioclada* bear a superficial resemblance to *T. heterophylla tenera* from which, however, as well as from all forms of *T. heterophylla* and from all other species of the eastern United States they are separated by the simple, straight hairs on the lower surface of the bract. Pubescence when present on the bract of other species is of fascicled hairs.

TILIA NEGLECTA Spach. This species can be separated from all other known species of eastern North America by the straight simple firmly attached pubescence on the lower surface of the leaves. Notwithstanding that this pubescence is soft and velvety to the touch, the leaves are green or slightly grayish beneath. The pubescence on the peduncle and on the bract when present is of fascicled hairs, however.

KEY TO SPECIES OF TILIA IN EASTERN UNITED STATES HAVING LOWER SURFACE OF LEAVES TOMENTOSE OR QUITE PUBESCENT AT FLOWERING TIME.

A. Pubescence or tomentum on lower surface of bract, if present, fascicled, close, soon becoming short; pubescence or tomentum on lower surface of leaves of fascicled hairs.
a. Midrib glabrous or nearly so at flowering time.
b. Flowers large, 10 to 12 mm. long. Tomentum on lower surface of leaves always white, dense and close but not velvety; twigs stout ..... *T. Michauxii*
b. Flowers smaller, 4 to 8 mm. long, twigs slender.
Leaves pubescent, terminal on shoots about twice as long as broad, never cordate or truncate at base, summer shoots tomentose, spring shoots glabrate ..... *T. porracea*
Terminal leaves on shoots relatively broader.
Bract at flowering time pubescent beneath, tomentum on lower surface of leaves soft and velvety, leaves at tips of twigs often brownish beneath.
Twigs glabrous ..... *T. heterophylla*
Twigs pubescent ..... *T. heterophylla nivea*
Bract at flowering time glabrate or merely pubescent beneath. Leaves on upper branches closely white-

tomentose beneath, lower merely pubescent, greenish or grayish.... *T. heterophylla tenera*

Bract oblong, rounded at both ends, at flowering time velvety tomentose beneath, pubescent above, leaves closely white-tomentose beneath.. *T. apposita*

a. Midrib tomentose or thickly pubescent below with stellate hairs, leaves very pubescent above while unfolding.

Leaves sharply dentate, often cordate, tomentose beneath, tomentum white or brown, but not a dusty brown, twigs tomentose, bract glabrous above..... *T. lata*

Leaves sharply dentate, very oblique, pubescence beneath dusty brown, bract glabrous above..... *T. caroliniana*

Leaves round-dentate, mostly cordate, covered beneath with dusty brown tomentum, bract pubescent above..... *T. georgiana*

A. Pubescence on lower surface of bract of long soft persistent white straight hairs; tomentum on lower surface of leaf loose and easily detached, fascicled.

Twigs glabrous at flowering time..... *T. eburnea*

Twigs pubescent with long straight hairs, leaves with a thick pubescence beneath..... *T. eburnea lasioclada*

A. Pubescence on lower surface of bract and on inflorescence, if present, fascicled; pubescence on lower surface of leaves of short, straight, firmly attached hairs ..... *T. neglecta*

Since incorrect citations of some of the species in the key have recently been published, it will perhaps be a convenience to have the following verified references:

T. MICHAUXII Nutt. N. A. Sylva **1**: 92. 1842.

T. PORRACEA Ashe, Charleston Museum Quart. **1**: 31. 1925.

T. HETEROPHYLLA Vent. Anales Hist. Nat. **2**: 68. 1800; Mém. Inst. Sci. Paris **4**[2]: 16. *pl. 5*. 1802.

T. HETEROPHYLLA NIVEA Sargent, Bot. Gaz. **66**: 507. 1918.

T. HETEROPHYLLA TENERA Ashe (see above).

T. APPOSITA Ashe, Bull. Charleston Museum **13**: 27. 1917.

T. LATA Ashe (see above).

T. CAROLINIANA Miller, Gard. Dict. Ed. 8. 1768. Sargent, Bot. Gaz. **66**: 496. 1918.

T. GEORGIANA Sargent, Bot. Gaz. **66**: 510. 1918.

T. EBURNEA Ashe, Bot. Gaz. **33**: 231. 1902.

T. EBURNEA LASIOCLADA (Sargent) Ashe (see above).

T. NEGLECTA Spach, Ann. Sci. Nat. Bot. II. **2**: 340. *pl. 15*. 1834. Sargent, Bot. Gaz. **66**: 494. 1918.

New plants from Colorado

George E. Osterhout

Atriplex virgata sp. nov. Annual, the stem terete and smooth, 3–6 dm. high, numerous branches above the middle of the stem 2–4 cm. long, though much longer on some of the plants; stem and leaves only moderately scurfy; the leaves crowded on the short branches, generally alternate, mostly ovate, 1–3 cm. long, 5–12 mm. wide, many smaller, cuneate at base, obtuse at the apex, entire or with a few small teeth, 3-nerved, sessile or the peduncles very short; fruiting bracts 1–4 in the axils of the leaves, and for the most part concealed by the leaves, 5 mm. wide at the base, the same in length, toothed on the sides at the base, though somewhat variable in this respect, the faces smooth, the pedicels very short; the seeds about 2 mm. in diameter, the radicle inferior.

Type collected by the writer, *no. 6520*, 5 October 1925, along the ravine south of Horsetooth Mountain, Larimer County, Colorado, growing in the shade of wild plum trees. No staminate flowers were evident at the time of collecting, but it has the appearance of being monoecious. The fruiting bracts are much like those of *A. rosea* L., but without appendages on the faces.

Sophia glandifera sp. nov. About 3 dm. high, light green, branched from the base with strongly ascending branches which equal, or almost equal, the main stem, the stem and the leaves dotted with small, very short-stalked glands; the lower leaves bipinnate, oblanceolate in outline, 4 cm. long including the petiole, the upper leaves sessile, pinnate with narrow segments; the pedicels ascending, 1 cm. long; the pods 8–10 mm. long, clavate, glabrous, 1–1.5 mm. thick; the seeds biserial; the flowers light yellow, the sepals 2 mm. long, the petals 2.5 mm. long, spatulate; the style sessile.

Type collected by the writer, *no. 5226*, 27 May 1915, at Hayden, Routt County, Colorado—just south of the town. The glandular character of the plant distinguishes it from other species of *Sophia*.

Miltitzia pinnatifida sp. nov. Annual, 6–15 cm. high, divided near the base into 2–4 branches which attain to nearly the same height, the whole plant hirsute; the leaves rather few,

oblanceolate in outline, 2–3 cm. long, divided half way to the midrib or almost to the midrib, the divisions oblong, obtuse, 3–4 mm. long; the inflorescence taking nearly the upper half of the plant with scorpioid racemes of numerous flowers and fruiting capsules, the calyx divided to the base, the lobes linear, obtuse, 2.5 mm. long in flower, becoming 6–8 mm. long in fruit, hirsute, two of the lobes a little larger than the others; the corolla the length of the calyx lobes, white or tinged with blue, the lobes small and rounded; the style 1 mm. long, divided near the top; the capsule 4 mm. long, 2-celled, splitting from the top into 2 valves; the seeds 15–20 in each capsule, 1 mm. long with 6–7 sharp cross ridges.

Type collected by the writer, *no. 6393*, 18 June 1925, west of Craig, Moffat County, Colorado—in sandy soil.

PTILORIA BIGELOVII (A. Gray) Woot. & Standl. Contr. U. S. Nat. Herb. **16:** 176. 1913. What I take to be this plant was collected in Moffat County, northwestern Colorado, a few miles east of the Utah line, June 20, 1925. So far as I know it has not been reported north of New Mexico.

INDEX TO AMERICAN BOTANICAL LITERATURE
1924–1925

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in the broadest sense.

Reviews, and papers that relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers at the rate of three cents for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the Index should be addressed to the Bibliographer of the Torrey Club, Mrs. Helen Smith Hill, Brooklyn Botanic Garden, Brooklyn, N. Y.

Adams, J. Some further experiments on the relation of light to growth. Am. Jour. Bot. **12:** 398–412. "Jl" 5 Au 1925.

Allen, J. M. Author and subject index to the publications on plant pathology issued by the United States department of agriculture up to January 1, 1925. U. S. Dept. Agr. Library Bibliog. Contr. **8:** 1–158. Je 1925.

Ames, O. New or noteworthy orchids. Sched. Orchid. 9: 1–62. *f. 1–9.* 22 Jl 1925.

22 species, in various genera, described as new.

Anderson, A. K. Biochemistry of plant diseases. The biochemistry of *Fusarium lini* Bolley. Univ. Minnesota Stud. Pl. Sci. **5:** 237–280. *f. I–II.* N 1924.

Andrews, F. M. Age of scale bark formation in *Carya ovata.* Proc. Indiana Acad. Sci. **34:** 267–270. "1924" 1925.

Andrews, F. M. Hydrogen-ion concentration of certain plant juices. Proc. Indiana Acad. Sci. **34:** 265–266. "1924" 1925.

Andrews, F. M. An unusual *Impatiens biflora.* Proc. Indiana Acad. Sci. **34:** 271–272. "1924" 1925.

Ashe, W. W. Notes on woody plants. Charleston Mus. Quar. 1^2: 28–32. 30 Je 1925.
Several species and combinations described as new.

Bade, E. When plants go to sleep. Gard. Chron. Am. **29:** 188–189. *illust.* Jl 1925.

Bailey, L. H. *Acanthosabal.* Gard. Chron. III. **77:** 396. *f. 180.* 6 Je 1925.

Ball, C. R., & Warburton, C. W. Mark Alfred Carleton. Jour. Am. Soc. Agron. **17:** 514–516. Au 1925.
Born 7 Mr 1866. Died 26 Ap 1925.

Barnhart, J. H. *Sherwoodia galacifolia.* Addisonia **10:**15–16. *pl. 328.* "Mr" 29 Je 1925.

Bartholow, F. A. Abbreviations employed in Experiment Station Record for titles of periodicals. U. S. Dept. Agr. Bull. 1330: 1–160. Jl 1925.

Bates, C. Z. Introducción de árboles exóticos. Revista Agr. Puerto Rico **14:** 305–307. My 1925.

Baxter, M. S., & House, H. D. The rare plants of Bergen swamp. N. Y. State Mus. Bull. 266: 103–106. *f. 4.* Je 1925.

Belling, J. The origin of chromosomal mutations in *Uvularia.* Jour. Genetics **15:** 245–266. *f. 1–11.* Jl 1925.

Benoist, R. La forêt et les bois de la Guyane française. Ann. Soc. Linn. Lyon n.s. **71:** 37–44. 1925.

Berger, A. *Roseocactus*, a new genus of Cactaceae. Gard. Chron. III. **77:** 415–416. *f. 188.* 13 Je 1925.

Berger, A. A taxonomic review of currants and gooseberries. New York Agr. Exp. Sta. Tech. Bull. 109: 1–118. *pl. 1–8.* D 1924.
Many species described as new.

Berkeley, G. H. Tomato diseases. Canada Dept. Agr. Bull. n. s. 51: 1–14. *f. 1–8.* 1925.

Berry, E. W. Fossil plants from the tertiary of Patagonia and their significance. Proc. Natl. Acad. Sci. **11:** 404–405. Jl 1925.

Boros, A. Two fossil species of mosses from the diluvial lime tufa of Hungary. Bryologist **28:** 29–32. *f. 6+pl. 3.* "My" 3 Au 1925.
Eucladium verticillatum, Didymodon tophaceus.

Boyd, O. C. Sweet potato seed improvement, disease control and rules pertaining to the plant industry. Georgia S. Bd. Entomology Bull. **67:** 1–10. F 1925.

Boynton, K. R. *Begonia Dregei.* Addisonia **10:** 13. *pl. 327.* "Mr" 29 Je 1925.

Boynton, K. R. *Begonia sanguinea.* Addisonia **10:** 7. *pl. 324.* "Mr" 29 Je 1925.

Boynton, K. R. First blooming of the daffodils. Jour. New York Bot. Gard. **26:** 121–123. *f. 1, 2.* Je 1925.

Boynton, K. R. Flowers for spring gardens. Jour. New York Bot. Gard. **26:** 131–132. Je 1925.

Boynton, K. R. *Pittosporum undulatum.* Addisonia **10:** 9–10. *pl. 325.* "Mr" 29 Je 1925.

Boynton, K. R. *Primula Sieboldii.* Addisonia **10:** 5. *pl. 323.* "Mr" 29 Je 1925.

Boyton, K. R. Tulips. Jour. New York Bot. Gard. **26:** 159–161. Jl 1925.

Boynton, K. R. *Zanthoxylum schinifolium.* Addisonia **10:** 11. *pl. 326.* "Mr" 29 Je 1925.

Braubach, C. Medicinal plants of the Aztecs which are still in common use in Mexico. Jour. Am. Pharm. Assoc. **14:** 498–505. Je 1925.

Britton, E. G. A freak of the mountain laurel. Jour. N. Y. Bot. Gard. **26:** 187–190. *f. 1.* Au 1925.

Britton, N. L. *Barbieria pinnata.* Addisonia **10:** 27. *pl. 334.* "Je" 6 Au 1925.

Britton, N. L. *Barleria prionitis.* Addisonia **10:** 17. *pl. 329.* "Je" 6 Au 1925.

Britton, N. L. *Byrsonima Horneana.* Addisonia **10:** 23. *pl. 332.* "Je" 6 Au 1925.

Britton, N. L. *Chamaecrista mirabilis.* Addisonia **10:** 29. *pl. 335.* "Je" 6 Au 1925.

Britton, N. L. *Distictis lactiflora.* Addisonia **10:** 31. *pl. 336.* "Je" 6 Au 1925.

Britton, N. L. *Erythrina Poeppigiana.* Addisonia **10:** 21. *pl. 331.* "Je" 6 Au 1925.

Britton, N. L. *Tabebuia haemantha.* Addisonia **10:** 25. *pl. 333.* "Je" 6 Au 1925.

Britton, N. L. *Urena lobata.* Addisonia **10:** 19. *pl. 330.* "Je" 6 Au 1925.

Brown, B. A., & Slate, W. L., Jr. Miscellaneous experiments with potatoes. Connecticut (Storrs) Agr. Exp. Sta. Bull. 126: 27–42. *f. 1.* Ja 1925.

Brown, H. D., Otten, R. J., & Reading, W. D. Factors influencing cyanide injury to greenhouse plants. Proc. Indiana Acad. Sci. **34:** 261–264. *f. 1.* "1924" 1925.

Brown, N. A. A new bacterial disease of tomato fruits. Science II. **62:** 12–13. 3 Jl 1925.

Brown, P. E., & Hart, W. J. Soil inoculation with *Azotobacter.* Jour. Am. Soc. Agron. **17:** 456–473. Au 1925.

Bruce, O. C. The relation of sulphur to alfalfa production. Jour. Agr. Res. **30:** 937–947. *pl. 1–3.* "15 My" Jl 1925.

Burke, V., & Burkey, L. Modifying *Rhizobium radicicolum.* Soil Sci. **20:** 143–147. *pl. 1.* Au 1925.

Burnham, S. H. Additions to the flora of the Lake George region. N. Y. State Mus. Bull. 266: 109–110. Je 1925.

Burnham, S. H., & Latham, R. A. The flora of the town of Southold, Long Island and Gardiner's Island, New York. Fifth supplementary list. Torreya **25:** 71–83. 19 Au 1925.
Several species described as new.

Butters, F. K., & Rosendahl, C. O. The distribution of the white oak in Minnesota. Univ. Minnesota Stud. Pl. Sci. **5:** 199–208. *f. 1+pl. 29.* N 1924.

Campbell, E. G. Potato leaf roll as affecting the carbohydrate, water, and nitrogen content of the host. Phytopathology **15:** 427–430. *f. 3.* Jl 1925.

Campos, J. D. A new specimen of *Lepidostrobus foliaceus.* Bot. Gaz. **79:** 441–449. *pl. 30–32.* 23 Je 1925.

Capinin, J. M. A study of Mendelian inheritance in natural hybrids of rosal (*Gardenia florida* L.). Philipp. Agr. **14:** 39–43. *f. 1+pl. 1.* Je 1925.

Carlson, F. A. The effect of soil structure on the character of alfalfa root systems. Jour. Am. Soc. Agron. **17:** 336–345. *f. 1–13.* Je 1925.

Chermezon, H. Cypéracées récoltées à la Guyane par M. Lemée. Bull. Soc. Bot. France **71:** 1047–1054. 1924.

Chun, W. Y. Two new trees from Chekiang. Jour. Arnold Arbor. **6:** 144–145. Jl 1925.
Halesia Macgregorei and *Torreya Jackii.*

Clute, W. N. The Virginia willow. Am. Bot. **31:** 93–94. *illust.* Jl 1925.

Coburn, L. H. The gentians of Somerset County. Maine Nat. **5:** 61–64. *illust.* 1 Je 1925.

Cockerell, T. D. A. Plant and insect fossils from the Green River Eocene of Colorado. Proc. U. S. Natl. Mus. **66**[19]**:** 1–13. *pl. 1,* 2. 1925.

Collinson, P. An account of the introduction of American seeds into Great Britain. Jour. Bot. **63:** 163–165. Je 1925.

Coons, G. H., & Kotila, J. E. The transmissible lytic principle (bacteriophage) in relation to plant pathogenes. Phytopathology **15:** 357–370. *pl. 9–12.* Jl 1925.

Coulter, J. M. The evolution of botany. Proc. Indiana Acad. Sci. **34:** 55–58. "1924" 1925.

Crocker, W. Seeds: their tricks and traits. Jour. N. Y. Bot. Gard. **26:** 178–187. Au 1925.

Darrow, G. M. The importance of sex in the strawberry. Jour. Hered. **16:** 193–204. *f. 1–7+frontispiece.* "Je" 11 Jl 1925.

David, P. A. A study of inheritance in tobacco crosses involving native and imported varieties. Philipp. Agr. **14:** 3–35. Je 1925.

Deam, C. C. Flora of Indiana: on the distribution of the ferns, fern allies and flowering plants. Proc. Indiana Acad. Sci. **34:** 39–52. "1924" 1925.

Dearness, J., & House, H. D. New or noteworthy species of fungi, IV. N. Y. State Mus. Bull. 266: 57–98. Je 1925.

Deats, M. E. The effect on plants of the increase and decrease of the period of illumination over that of the normal day period. Am. Jour. Bot. **12:** 384–392. *pl. 38, 39.* "Jl" 5 Au 1925.

Delauney, L. The S-chromosomes in *Ornithogalum* L. Science II. **62:** 15–16. *f. 1.* 3 Jl 1925.

Douglass, A. E. Tree rings and climate. Sci. Mo. **21:** 95–99. Jl 1925.

Durham, G. B. Has parthenogenesis been confused with hermaphroditism in the *Cucurbita?* (Preliminary report.) Zeit. Indukt. Abst. u. Verer. **37:** 358–361. 1925.

Durland, W. D. Porto Rico's violet tree. Am. For. & For. Life **31:** 475. *illust.* Au 1925.
Phlebotaenia Cowellii.

Durrell, L. W. *Basisporium* dry rot of corn. Iowa Agr. Exp. Sta. Res. Bull. 84: 138–160. *f. 1–12.* My 1925.

Durrell, L. W. A root rot of alfalfa. Sci. II. **72:** 82–83. 24 Jl 1925.

Eaton, M. A. Pages from the floral life of America. Natl. Geog. **48:** 44–75. *col. pl. 1–24.* Jl 1925.

Elliott, J. A. A cytological study of *Ceratostomella fimbriata* (E. & A.) Elliott. Phytopathology **15:** 417–422. *pl. 15, 16.* Jl 1925.

Eyster, W. H. Mosaic pericarp in maize. Genetics **10:** 179–196. *f. 1–6.* "Mr" 8 Jl 1925.

Ezekiel, W. N. Fruit-rotting Sclerotinias. II. The American brown-rot fungi. Maryland Agr. Exp. Sta. Bull. 271: 87–144. *f. 1–22.* O 1924.

Farr, C. H. Root-hair elongation in Knop's solution and in tap water. Am. Jour. Bot. **12:** 372–383. "Jl" 5 Au 1925.

Fawcett, W., & Rendle, A. B. *Laurus americana* Miller. Jour. Bot. **63:** 51. F 1925.

Fernald, M. L. Another *Arnica* from Newfoundland. Rhodora **27:** 90–92. "My" 7 Jl 1925.
Arnica terrae-novae.

Fernald, M. L. The maritime plantains of North America. Rhodora **27:** 93–104. *pl. 150.* "Je" 16 Jl 1925.
Several varieties described as new.

Fernald, M. L. Notes on *Sagina.* Rhodora **27:** 130–131. "Jl" 10 Au 1925.
1 combination and 1 variety, described as new.

Fernald, M. L. Persistence of plants in unglaciated areas of boreal America. Mem. Am. Acad. Arts & Sci. **15:** 239–342. *maps.* 21 Au 1925.
Memoirs Gray Herbarium II.

Fernald, M. L. *Pontederia* versus *Unisema.* Rhodora **27:** 76–81. "My" 7 Jl 1925.
1 form and 1 combination described as new.

Fiske, J. G. Poisonous weeds of New Jersey not hard to identify. New Jersey Agr. **7**[8]: 3. Au 1925.

Fitch, H. W. Quantitative determination of sulfur fungicides on foliage. Phytopathology **15:** 351–354. "Je" 15 Jl 1925.

Friesner, R. C. A variation of *Trillium declinatum* (Gray) Gleason. Proc. Indiana Acad. Sci. **34:** 315. "1924" 1925.

Gager, C. S. How to think about evolution. Jour. New York Bot. Gard. **26:** 157–158. Jl 1925.

Gaines, E. F. The inheritance of disease resistance in wheat and oats. Phytopathology **15:** 341–349. "Je" 15 Jl 1925.

Gandoger, M. La flore des îles Kerguelen (Amérique-australe). Bull. Soc. Bot. France **72:** 177–180. Ja-F 1925.

Gardner, M. W. Indiana plant diseases, 1923. Proc. Indiana Acad. Sci. **34:** 297–313. *f. 1–3.* "1924" 1925.

Gardner, M. W. Necrosis, hyperplasia, and adhesions in mosaic tomato fruits. Jour. Agr. Res. **30:** 871–888. *f. 1+ pl. 1–8.* "1 My" Je 1925.

Garrison, H. S., & Richey, F. D. Effects of continuous selection for ear type in corn. U. S. Dept. Agr. Bull. 1341: 1–11. *f. 1, 2.* Au 1925.

Gilbert, A. H. "Giant hill" potatoes, a dangerous source of seed, a new phase of spindle-tuber. Vermont Agr. Exp. Sta. Bull. 245: 1–16. *f. 1–6.* My 1925.

Ginsburg, J. M. Composition and appearance of soybean plants grown in culture solutions each lacking a different essential element. Soil. Sci. **20:** 1–13. *f. 1.* Jl 1925.

Ginsburg, J. M. A modified respiration apparatus for plant and soil studies. Soil. Sci. **19:** 411–414. *pl. 1.* Je 1925.

Gleason, H. A. Java and the Javanese people. Jour. New York Bot. Gard. **26:** 158–159. Jl 1925.

Gleason, H. A. A set of Gardner's plants from Brazil. Jour. New York Bot. Gard. **26:** 134–135. Je 1925.

Goss, R. W. Two important groups of Nebraska potato diseases. I. Potato wilt and tuber rots. II. "Run out" potatoes caused by degeneration diseases. Nebraska Agr. Coll. Ext. Serv. Circ. 1256: 1–23. *f. 1–7.* Ap 1925.

Gregory, C. T. Cabbage diseases in Indiana. Proc. Indiana Acad. Sci. **34:** 283–284. "1924" 1925.

Gregory, C. T. The loose and stinking smuts in Indiana. Proc. Indiana Acad. Sci. **34:** 285–288. *f. 1.* "1924" 1925.

Gress, E. M. Our orchids—aristocrats of the woods. Am. For. & For. Life **31:** 479–482, 498. *illust.* Au 1925.

Gress, E. M. Preservation of wild flowers in Pennsylvania. Pennsylvania Dept. Agr. Bull. **8**[3]: 1–17. *f. 1–8.* Mr 1925.

Griffee, F. Correlated inheritance of botanical characters in barley, and manner of reaction to *Helminthosporium sativum.*

Jour. Agr. Res. **30:** 915–935. *f. 1 + pl. 1, 2.* "15 My" Jl 1925.

Groves, J. Fossil Charophyte-fruits from Texas. Am. Jour. Sci. V. **10:** 12–14. *f. 1–3.* Jl 1925.
Chara Brewsterensis, *C. Gardnerae* and *C. texensis* described as new species.

Guba, E. F. Literature on fungous floras in North America and an addition to a "Check list of references dealing with the taxonomy of the fungi." Trans. Am. Micros. Soc. **44:** 109–118. Ap 1925.

Gustafson, F. G. Diurnal changes in the acidity of *Bryophyllum calycinum.* Jour. Gen. Physiol. **7:** 719–728. *f. 1–6.* 20 Jl 1925.

Haenseler, C. M. Plant diseases of New Jersey. (Sixth instalment.) Brown rot of stone fruits. New Jersey Agr. **7**[8]**:** 6–7. *f. 1, 2.* Au 1925.

Haenseler, C. M., & Martin, W. H. Arsenical injury of the peach. Phytopathology **15:** 321–331. *f. 1–4.* "Je" 15 Jl 1925.

Hamblin, S. F. American hydrangeas. Nat. Mag. **6:** 164–166. *illust.* S 1925.

Hansen, A. A. Mechanical injuries caused by weeds and other plants. Proc. Indiana Acad. Sci. **34:** 229–254. *f. 1–14.* "1924" 1925.

Hansen, A. A. Recent Indiana weeds, 1924. Proc. Indiana Acad. Sci. **34:** 256–258. *f. 1.* "1924" 1925.

Hansen, A. A. Water hemlock, *Cicuta maculata* L., a biennial in Indiana. Proc. Indiana Acad. Sci. **34:** 255–256. *f. 1.* "1924" 1925.

Hanson, H. C. Codes of nomenclature and botanical congresses. Am. Bot. **31:** 114–120. Jl 1925.

Harper, R. M. A botanically remarkable locality in the Tallahassee red hills of middle Florida. Torreya **25:** 45–54. *illust.* "My-Je" 2 Jl 1925.

Harris, J. A. Correlation and machine calculation. Am. Nat. **59:** 363–366. Jl–Au 1925.

Harshberger, J. W. Flowers from Abraham's city. Gard. Mag. & Home Builder **41:** 480. *illust.* Au 1925.

Harshberger, J. W. Notes on the Portuguese insectivorous plant, *Drosophyllum lusitanicum.* Proc. Am. Phil. Soc. **64:** 51–54. *pl. 1, 2.* 1925.

Harter, L. L. A physiological study of *Mucor racemosus* and *Diplodia tubericola*—two sweet potato storage-rot fungi. Jour. Agr. Res. **30:** 961–969. "15 My" Jl 1925.

Hartman, H. The control of core break-down in pears. Oregon Agr. Exp. Sta. Bull. 216: 1–16. *f. 1, 2.* Je 1925.

Hartt, C. E. Conditions for germination of spores of *Onoclea sensibilis.* Bot. Gaz. **79:** 427–440. *f. 1 + pl. 29.* 23 Je 1925.

Harvey, E. M. Phloridzin. I. The significance of phloridzin in apple and pear tissue. II. The hydrolysis and estimation of phloridzin. Oregon Agr. Exp. Sta. Bull. 215: 1–23. *f. 1–7.* Je 1925.

Harvey, R. B. Sun scald of tomatoes. Univ. Minnesota Stud. Pl. Sci. **5:** 229–234. *f. 1, 2 + pl. 30.* N 1924.

Hassler, E. Revisio specierum austro-americanarum generis *Phaseoli* L. Candollea **1:** 417–472. "My 1923" 1925.

Hastings, E. G., & Fred, E. B. Bacteria feed legumes with air nitrogen. Wisconsin Coll. Agr. Ext. Service Circ. 185: 1–20. *illust.* My 1925.

Hayes, H. K., Stakman, E. C., & Aamodt, O. S. Inheritance in wheat of resistance to black stem rust. Phytopathology **15:** 371–386. *pl. 13.* Jl 1925.

Hazen, T. E. Botanizing in the Colombian Andes. Jour. New York Bot. Gard. **26:** 132–133. Je 1925.

Henderson, N. F. Ohio mosses, Polytrichales. Ohio Jour. Sci. **25:** 177–182. 21 Jl 1925.

Henry, A. W., & Gilbert, H. C. Important fungous diseases of the common sunflower. Univ. Minnesota Stud. Pl. Sci. **5:** 295–305. *pl. 32, 33.* N 1924.

Herzog, T. Neue Bryophyten aus Brasilien. Repert. Spec. Nov. Reg. Veg. **21**: 22–38. *pl. 9–11.* Mr 1925.

Hitchings, B. G. [Some results of the first season's work at the University of Maine's summer biological station at Mount Desert Island, 1924] pt. 5. The white pine region. Maine Nat. **5**: 82–90. 1 Je 1925.

Hoffman, I. C. The vegetable regions of Indiana. Proc. Indiana Acad. Sci. **34**: 273–276. *f. 1.* "1924" 1925.

Holm, T. Hibernation and rejuvenation, exemplified by North American herbs. Am. Midl. Nat. **9**: 439–476. *pl. 1–5.* My 1925; 477–512. Jl 1925.

Holzinger, J. M. *Grimmia crinita* Bridel, var. *capillata* DeNot., in North America. Bryologist **28**: 32. "My" 3 Au. 1925.

Holzinger, J. M. Some European mosses unrecorded from North America. Bryologist **28**: 34. "My" 3 Au 1925.
Oligotrichum incurvum, Catharinaea undulata minor, Dicranella humilis.

Hopkins, J. C. Notes on the soft rot of cotton bolls in the West Indies caused by *Phytophthora.* Ann. Bot. **39**: 267–280. *f. 1–17.* Ap 1925.

Hottes, A. C. About wild flowers. Ohio State Univ. Ext. Serv. Bull. **20**^{6}: 1–19. *f. 1–8.* 1925.

House, H. D. Local flora notes, IX. N. Y. State Mus. Bull. 266: 11–27. Je 1925.

House, H. D. Notes on fungi, IX. N. Y. State Mus. Bull. 266: 41–56. *f. 1.* Je 1925.

House, H. D. Vegetation of the eastern end of Oneida Lake. Supplementary account. N. Y. State Mus. Bull. 266: 28–40. Je 1925.

Howitt, J. E. The nature of disease in plants. Ann. Rept. Veg. Grow. Assoc. Ontario **20**: 31–36. *illust.* 1925.

Hu, H. H. Further notes on Chinese ligneous plants. Jour. Arnold Arbor. **6**: 140–143. 30 Jl 1925.
Several species and combinations described as new.

Hu, H. H. Nomenclatorial changes for some Chinese orchids. Rhodora **27:** 105–107. "Je" 16 Jl 1925.
Many combinations and 1 name described as new.

Hucker, G. J. The species of the genus *Micrococcus*. Central. Bakt. II Abt. **64:** 481–491. 20 Jl 1925.

Hurd-Karrer, A. M. Acidity and varietal resistance of wheat to *Tilletia Tritici*. Am. Jour. Bot. **12:** 359–371. "Jl" 5 Au 1925.

Hyde, K. C. Tropical light weight woods. Bot. Gaz. **79:** 380–411. *pl. 26–28.* 23 Je 1925.

Illick, J. S. The black oaks. Am. For. & For. Life **31:** 488–493. *illust.* Au 1925.

Jackson, H. S. A convenient laboratory plant press. N. Y. State Mus. Bull. 266: 99–101. *f. 2, 3.* Je 1925.

Jodidi, S. L., & Wangler, J. G. Physiological and biochemical studies on cereals. IV. On the presence of amino acids and polypeptides in the ungerminated rye kernel. Jour. Agr. Res. **30:** 989–994. "15 My" Jl 1925.

Johnson, D. W. The New England-Acadian shore line. i–xx, 1–608. *f. 1–273.* New York, 1925.
Chapters 16 and 17 contain ecological notes on salt marshes.

Jones, D. B., Gersdorff, C. E. F., & Moeller, O. Proteins of the bark of the common locust tree, *Robinia pseudacacia*. I. Jour. Biol. Chem. **64:** 655–671. Jl 1925.

Jones, D. F., & Mangelsdorf, P. C. The improvement of naturally cross-pollinated plants by selection in self-fertilized lines. I. The production of inbred strains of corn. Connecticut Agr. Exp. Sta. Bull. 266: 349–418. *f. 16–62.* Mr 1925.

Kellogg, V. Variations and mutations. Sci. Mo. **21:** 136–137. Au 1925.

Kikuchi, A. Variation in size and form of *Pyrus serotina*. Bot. Gaz. **79:** 412–426. *f. 1.* 23 Je 1925.

Killip, E. P. New tropical American species of Urticaceae. Jour. Washington Acad. Sci. **15:** 289–299. 19 Jl 1925.
Species in *Pilea*, and *Pouzolzia phenacoides* described as new.

Klugh, A. B. Ecological photometry and a new instrument for measuring light. Ecology **6:** 203–237. *f. 1–5* + *pl. 3.* 15 Jl 1925.

Knowlton, C. H. Edward Blanchard Chamberlain. Rhodora **27:** 73–76. "My" 7 Jl 1925.
Born 24 Jl 1878. Died 2 F 1925.

Koehler, B., Dungan, G. H., & Holbert, J. R. Factors influencing lodging in corn. Illinois Agr. Exp. Sta. Bull. 266: 311–371. *f. 1–25.* My 1925.

Kotila, J. E., & Coons, G. H. Investigations on the blackleg disease of potato. Michigan Agr. Exp. Sta. Tech. Bull. 67: 1–29. *pl. 1–7.* My 1925.

Krantz, F. A. Potato breeding methods. Minnesota Dept. Agr. Tech. Bull. 25: 1–32. *f. 1–5.* D 1924.

Kräusel, R. Beiträge zur Kenntnis der fossilen Flora Südamerikas. Arkiv för Bot. **19⁹:** 1–36. *f. 1–3* + *pl. 1–4.* 20 O 1924.

Knudson, L. Physiological study of the symbiotic germination of orchid seeds. Bot. Gaz. **79:** 345–379. 23 Je 1925.

Larson, A. H., & Ure, R. Some factors affecting the germination of lettuce seed. Univ. Minnesota Stud. Pl. Sci. **5:** 289–294. *illust.* N 1924.

Lauritzen, J. I., & Harter, L. L. The influence of temperature on the infection and decay of sweet potatoes by different species of *Rhizopus*. Jour. Agr. Res. **30:** 793–810. *f. 1–9.* "1 My" Je 1925.

Lee, H. A. The comparative resistance to foot rot of various citrus species as root stocks. Philipp. Jour. Sci. **27:** 243–254. *f. 1* + *pl. 1.* Je 1925.

Leffmann, H. A poet-botanist. Am. Jour. Pharm. **97:** 443–445. Jl 1925.
Adelbert von Chamisso.

Leonard, L. T. Lack of nodule-formation in a subfamily of the Leguminosae. Soil Sci. **20:** 165–167. Au 1925.

Leonian, L. H. Physiological studies on the genus *Phytophthora*. Am. Jour. Bot. **12:** 444–498. *f. 1–7 + pl. 45–57.* "Jl" 5 Au 1925.

Linford, M. B. "Utah"—a veteran juniper. Am. For. & For. Life **31:** 485, 499. *illust.* Au 1925.
Specimen of *Juniperus scopulorum* 21 feet 6 inches in circumference.

Lipman, J. G. The fixation of nitrogen under field conditions. Jour. Am. Soc. Agron. **17:** 450–455. Au 1925.

Lohnis, F. Bacterial nitrogen fixation. Jour. Am. Soc. Agron. **17:** 445–450. Au 1925.

Lynge, B. On South American *Anaptychiae* and *Physciae*. Vidensk. Skrifter Math.-Nat. Kl. **2**[16]: 1–47. *pl. 1–5.* "1924" 5 Ja 1925.

McAtee, W. L. Notes on drift, vegetable balls, and aquatic insects as a food product of inland waters. Ecology **6:** 288–302. 15 Jl 1925.

MacDougal, D. T. Accretion and distention in plant cells. Am. Nat. **59:** 336–345. Jl–Au 1925.

MacDougal, D. T. Growth in trees. Sci. Mo. **21:** 99–103. Jl 1925.

McKelvey, S. D. *Syringa rugulosa*, a new species from western China. Jour. Arnold Arbor. **6:** 153–154. 30 Jl 1925.

Mackenzie, K. K. Proper use of the name *Filix*. Am. Fern Jour. **15:** 40–45. "Ap–Je" 30 Je 1925.

McMurray, N. Stout ragged goldenrod. Am. Bot. **31:** 125–126. Jl 1925.

McNair, J. B. The geographical distribution of poison sumac (*Rhus Vernix* L.) in North America. Am. Jour. Bot. **12:** 393–397. *f. 1 + pl. 40.* "Jl" 5 Au 1925.

Mains, E. B. Observations concerning the disease susceptibility of cereals and wild grasses. Proc. Indiana Acad. Sci. **34:** 289–295. *f. 1–3.* "1924" 1925.

Martin, E. M. *Taphrina communis* and *Taphrina mirabilis*. Phytopathology **15:** 431. Jl 1925.

Martin, G. W. Paradichlorobenzene in the herbarium. Bot. Gaz. **79:** 450. 23 Je 1925.

Maxon, W. R. New tropical American ferns—II. Am. Fern Jour. **15:** 54–57. "Ap–Je" 30 Je 1925.
Alsophila Gleasoni and *Alsophila borinquena* described as new species.

Merrill, E. D. Additions to our knowledge of the flora of Hainan. Jour. Arnold Arbor. **6:** 129–140. 30 Jl 1925.
Many species described as new.

Merrill, E. D. Additions to our knowledge of the Philippine flora—I. Philipp. Jour. Sci. **26:** 447–496. Ap 1925.
3 genera, *Mappia*, *Lettsomia*, and *Didymocarpus*, and 54 species, described as new.

Merrill, E. D. Explanatory note. Hilgardia **1:** i–ii. My 1925.

Merrill, E. D. Five new species of Chinese plants. Philipp. Jour. Sci. **27:** 161–166. Je 1925.
Caesalpinia Tsoongii, *Meliosma Stewardii*, *Lagerstroemia Limii*, *Embelia hainanensis*, *Elatostema Stewardii*.

Merrill, E. D. New species of Philippine plants collected by A. Loher. Philipp. Jour. Sci. **27:** 21–59. My 1925.

Metcalf, M. M. *Amanita muscaria* in Maine. Science II. **61:** 567. 29 My 1925.

Middleton, W. S. John Bartram, botanist. Sci. Mo. **21:** 191–216. *illust.* Au 1925.

Millspaugh, C. F. Herbarium organization. Field Mus. Nat. Hist. Publ. Mus. Tech. Ser. 1: 1–18. *f. 1–9.* Je 1925.

Mousley, H. Further notes on *Calypso*. Torreya **25:** 54–59. *f. 1–13.* "My–Je" 2 Jl 1925.

Moxley, E. A. A bryologist's paradise. Bryologist **28:** 33. "My" 3 Au 1925.
Bruce Peninsula, between Georgian Bay and Lake Huron.

Muenscher, W. C. A *Sequoia* far from its home. N. Y. State Mus. Bull. 266: 108–109. Je 1925.
S. gigantea at Cayuga Lake.

Muller, H. J. Why polyploidy is rarer in animals than in plants. Am. Nat. **59:** 346–353. Jl–Au 1925.

Mulvania, M. Cultivation of the virus of tobacco mosaic by the method of Olitsky. Science II. **62:** 37. 10 Jl 1925.

Murrill, W. A. Meet the puffballs. Nat. Mag. **6:** 101–104. *illust.* Au 1925.

Murrill, W. A. Note on abnormal fruiting in the cinnamon fern. Am. Fern Jour. **15:** 66. 30 Je 1925.

Murrill, W. A. Sketches of travel in South America—the ascent of Corcovado. Torreya **25:** 69–70. 19 Au 1925.

Nakai, T. Joseph Banks: Icones selectae plantarum quas in Japonia collegit et delineavit Engelbertus Kaempfer. Jour. Arnold Arbor. **6:** 186–188. 30 Jl 1925.

Nakai, T. Two new genera of Bambusaceae, with special remarks on the related genera growing in eastern Asia. Jour. Arnold Arbor. **6:** 145–154. 30 Jl 1925.
Pleioblastus, Indocalamus.

Nowell, W. Coconut bud-rot in Trinidad. Trop. Agriculturist **64:** 277. My 1925.

O Neal, C. E. A new station for *Discellum nudum.* Bryologist **28:** 34–35. "My" 3 Au 1925.

Orton, C. R., & Olson, O. I. Tobacco resistant to black root-rot in Pennsylvania. II. A method of eliminating experimental error in comparative field tests. Pennsylvania Agr. Exp. Sta. Bull. 193: 1–15. *pl. 1–4.* Mr 1925.

Parker, F. W. The carbon dioxide content of the soil air as a factor in the absorption of inorganic elements by plants. Soil Sci. **20:** 39–44. Jl 1925.

Peattie, D. C. The flora of an historic wall. Am. Midl. Nat. **9:** 381–383. My 1925.

Peattie, D. C. Plants of Wolf Lake, Indiana-Illinois. Am. Bot. **31:** 94–99. Jl 1925.

Peckham, E. A. S. Narcissi, or daffodils. Jour. New York Bot. Gard. **26:** 127–129. Je 1925.

Peckham, E. A. S. *Puschkinia scilloides.* Addisonia **10:** 3–4. *pl. 322.* "Mr" 29 Je 1925.

Porter, C. L. Phenomena exhibited by fungi when grown in close proximity. Proc. Indiana Acad. Sci. **34:** 259–260. "1924" 1925.

Rankin, H. A. Abberrant yellow jessamine. Am. Bot. **31:** 128–129. Jl 1925.

Reagan, A. B. Identification of two fossil leaves from Iowa, one from Arizona and a "tree trunk" from Kansas. Proc. Indiana Acad. Sci. **34:** 141–142. *f. 1.* "1924" 1925.
Salix siouxiana, Nilsonia steamboatea and *Stigmaria ficoides.*

Reed, H. S. Recent work on physiology of citrus leaves. Calif. Citrogr. **10:** 312, 336, 337. *illust.* Jl 1925.

Rehder, A. *Amelasorbus,* a new bigeneric hybrid. Jour. Arnold Arbor. **6:** 154–156. 30 Jl 1925.

Rigg, G. B. Some sphagnum bogs of the north Pacific coast of America. Ecology **6:** 260–278. *pl. 4.* 15 Jl 1925.

Robbins, W. W. Some fundamental principles of plant growth. I. The living plant body and its work. Through the Leaves **12:** 584–586. 1924.

Robbins, W. W. Some fundamental principles of plant growth. VI. The loss of water from plants (transpiration). Through the Leaves **13:** 195–197. My 1925; VII. The basis of drought resistance in plants. Through the Leaves **13:** 253–255. Je 1925; VIII. Vegetative growth and reproduction. Through the Leaves **13:** 286–287. Jl 1925.

Robinson, B. L. Asa Gray. Science II. **62:** 45–46. 17 Jl 1925.

Roeding, G. C. *Sequoia gigantea.* Gard. Chron. III. **78:** 107. *f. 41 + suppl. pl.* 8 Au 1925.

Rudolfs, W. Influence of water and salt solution upon absorption and germination of seeds. Soil Sci. **20:** 15–37. *f. 1–3.* Jl 1925.

Rusby, H. H. What people drink and why. Jour. New York Bot. Gard. **26:** 151–157. Jl 1925.

Rydberg, P. A. Notes on Fabaceae—IV. *Xylophacos* Rydberg. Bull. Torrey Club **52:** 143–156. "Ap" 18 My 1925; —V. *Xylophacos* (contin.) Bull. Torrey Club **52:** 229–235. "My" 7 Je 1925; —VI. *Xylophacos* (concl.) Bull. Torrey Club **52:** 365–372. "O" 20 N 1925.

Safford, W. E. Foods discovered with America. Sci. Mo. **21:** 181–186. Au 1925.

Safford, W. E. The potato of romance and of reality—II. The potato of reality. Jour. Hered. **16:** 175–184. *f. 17–24.* "My" 12 Je 1925; —III. Introduction of the potato into culture. Jour. Hered. **16:** 217–230. *f. 12–18.* "Je" 11 Jl 1925.

Schaffner, J. H. The influence of the substratum on the percentage of sex reversal in winter-grown hemp. Ohio Jour. Sci. **25:** 172–176. 21 Jl 1925.

Schaffner, J. H. Synopsis considered as a sexual phenomenon. Ohio Jour. Sci. **25:** 183–189. 21 Jl 1925.

Schuster, C. E. Pollination and growing of the cherry. Oregon Agr. Exp. Sta. Bull. 212: 1–40. *f. 1–14.* My 1925.

Schweinfurth, C. *Cypripedium reginae* in New Hampshire. Rhodora **27:** 107–109. "Je" 16 Jl 1925.

Seal, J. L. Biologic specialization in *Sclerotinia* sp. The organism causing brown rot of fruits. Univ. Minnesota Stud. Pl. Sci. **5:** 281–287. *pl. 31.* N 1924.

Seaver, F. J. Porto Rico and the American Virgin Islands. Jour. New York Bot. Gard. **26:** 124–127. Je 1925.

S[etchell], W. A. Townshend Stith Brandegee. Science II. **61:** 464. 1 My 1925.
Born 16 F 1843. Died 7 Ap 1925.

Setchell, W. A., & Gardner, N. L. The marine algae of the Pacific coast of North America. Pt. III. Melanophyceae. Univ. Calif. Publ. Bot. **8:** 383–398. *pl. 34–107.* 26 Je 1925.

Shamel, A. D., Pomeroy, C. S., & Caryl, R. E. Bud selection in the Washington navel orange. Jour. Hered. **16:** 233–241. *f. 1–5.* 28 Jl 1925.

Shapovalov, M. Ecological aspects of a pathological problem (western yellow blight of tomatoes). Ecology **6:** 241–259. *f. 1–5.* 15 Jl 1925.

Shedd, O. M. The relation of some chemical constituents to the grades of Kentucky tobacco. Kentucky Agr. Exp. Sta. Bull. 258: 33–58. Ap 1925.

Small, J. K. An additional *Anychia* from Pennsylvania. Torreya **25:** 59–61. "My-Je" 2 Jl 1925.
A. Nuttalli.

Small, J. K. *Dionaea muscipula.* Addisonia **10:** 1–2. *pl. 321.* "Mr" 29 Je 1925.

Small, J. K. The scrub-palmetto—*Sabal Etonia.* Jour. New York Bot. Gard. **26:** 145–151. *f. 1, 2.* Jl 1925.

Smith, R. E., & Smith, E. H. Further studies on Pythiaceous infection of deciduous fruit trees in California. Phytopathology **15:** 389–404. *f. 1–6.* Jl 1925.

Standley, P. C. New plants from Central America—III. Jour. Washington Acad. Sci. **15:** 285–289. 19 Jl 1925.

Stapf, O. *Maxillaria lepidota.* Curt. Bot. Mag. **150:** *pl. 9065.* 29 Je 1925.
Native of Colombia and Ecuador.

Stevens, J. W. A study of various strains of *Bacillus radicicola* from nodules of alfalfa and sweet clover. Soil Sci. **20:** 45–65. *pl. 1, 2.* Jl 1925.

Stevens, N. E., & Wilcox, M. S. The citrus stem-end rot "*Diplodia*"; its life history and relation to *Sphaeropsis malorum.* Phytopathology **15:** 332–340. *pl. 8.* "Je" 15 Jl 1925.

Stadler, L. J. Variation in the intensity of linkage in maize. Am. Nat. **59:** 366–370. Jl–Au 1925.

Stakman, E. C., Lambert, E. B., & Flor, H. H. Varietal resistance of spring wheats to *Tilletia levis.* Univ. Minnesota Stud. Pl. Sci. **5:** 307–317. N 1924.

Stanford, E. E. Possibilities of hybridism as a cause of variation in *Polygonum.* Rhodora **27:** 81–89. "My" 7 Jl 1925.

Stiles, H. R., Peterson, W. H., & Fred, E. B. Fermentation products of certain mannitol-forming bacteria. Jour. Biol. Chem. **64:** 643–654. Jl 1925.

Stout, A. B. New day lilies. Jour. N. Y. Bot. Gard. **26:** 169–178. *f. 1–3.* Au 1925.

Sydow, H. Fungi from the province of Sorsogon. Leaflet Philipp. Bot. **9:** 3113–3138. 20 Ap 1925.

Taylor, G. R. Winter treatment of algal growths. Water Works Issue, Engineering & Contracting **63:** 123–124. 1925.

Transeau, E. N. The genus *Debarya*. Ohio Jour. Sci. **25:** 193–201. *pl. 1, 2.* 21 Jl 1925.

Trelease, W. The evolution of a botanist and of a department of botany. Proc. Indiana Acad. Sci. **34:** 59–62. "1924" 1925.

Twitchell, E., & Crockett, R. Some results of the first season's work at the university of Maine's summer biological station at Mount Desert Island, 1924. pt. 4. Report of the mixed conifer region on Pickett mountain. Maine Nat. **5:** 65–81. *illust.* 1 Je 1925.

Uphof, J. C. T. The importance of abstracting old botanical works and manuscripts. New Phytologist **24:** 190–191. 12 Au 1925.

Uphof, J. C. T. Das Verhalten von *Pucciniopsis caricae* Earle auf der Papaya (*Carica papaya*) in Florida. Zeit. Pflanzenkrank. **35:** 118–122. *f. 1, 2.* 1925.

Van Hook, J. M. Indiana fungi—VIII. Proc. Indiana Acad. Sci. **34:** 317–320. "1924" 1925.

Wahlen, F. T. The determination of the origin of agricultural seeds with special reference to red clover. Sci. Agr. **5:** 369–374. Au 1925.

Weatherby, C. A. Inconstancy in color-forms of *Hepatica americana*. Rhodora **27:** 131–132. "Jl" 10 Au 1925.

Weatherwax, P. Notes on grasses—II. Proc. Indiana Acad. Sci. **34:** 227–228. "1924" 1925.

Weatherwax, P. The reported origin of Indian corn from teosinte. Proc. Indiana Acad. Sci. **34:** 225–227. *f. 1–7.* "1924" 1925.

Weimer, J. L., & Harter, L. L. Varietal resistance of sweet potatoes to nematodes, *Heterodera radicicola* (Greaf.) Muller, in California. Phytopathology **15:** 423–426. Jl 1925.

Weiss, F. The conditions of infection in potato wart. Am. Jour. Bot. **12:** 413–443. *f. 1–3 + pl. 41–44.* "Jl" 5 Au 1925.

Werner, H. O. The spindle-tuber disease. One cause of "run-out" seed potatoes. Nebraska Agr. Exp. Sta. Bull. 207: 1–21. *f. 1–13.* Ap 1925.

Westwood, R. W. Rubber—nature's tropical gift. Nat. Mag. **6:** 91–95. *illust.* Au 1925.

Wherry, E. T. The Appalachian Aspleniums. Am. Fern Jour. **15:** 47–54. *pl. 4.* "Ap–Je" 30 Je 1925.
A. Stotleri and *A. Trudelli* described as new species.

Wherry, E. T. A new acid-soil onion from West Virginia. Jour. Washington Acad. Sci. **15:** 370–372. 19 S 1925.
Allium oxyphilum.

Whetzel, H. H. The story of the apple scab and its control. Proc. New York State Hort. Soc. **70:** 159–162. 1925.

White, O. E. Inheritance studies in Pisum. V. The inheritance of scimitar pod. Genetics **10:** 197–210. *f. 1–10.* 21 S 1925.

White, O. E. A leaf color seedling variation in *Duguetia.* Jour. Hered. **16:** 381–382. *f. 13.* 5 N 1925.

Wiegand, K. M. *Oxalis corniculata* and its relatives in North America. Rhodora **27:** 113–124, 133–139. "Jl," "Au" 10 Au, 26 S 1925.
Several varieties and combinations described as new.

Wiegand, K. M. Some changes in nomenclature. Rhodora **27:** 186–187. "O" 5 N 1925.
Sagittaria latifolia var. *obtusa* and *Armoracia aquatica,* described as new combinations.

Wieland, G. R. Triaso-Jurassic plant evolution and climate. Am. Nat. **59:** 452–474. S–O 1925.

Wiggans, R. G. Variations within and between morphological varieties of oats and barley. Cornell Agr. Exp. Sta. Mem. 94: 1–35. *f. 1–4.* Jl 1925.

Wiley, H. W. Professor Robinson's tribute to Asa Gray. Science II. **62:** 222–223. 4 S 1925.

Willaman, J. J., Pervier, N. C., & Triebold, H. O. Biochemistry of plant diseases. V. Relation between susceptibility to brown rot in plums and physical and chemical properties. Bot. Gaz. **80:** 121–144. *f. 1–10.* 23 O 1925.

Williams, R. S. Some undescribed mosses from Colombia. Bryologist **28:** 59–64. *pl. 7.* "Jl–S" 24 O 1925.

1 genus, *Neobryum*, and several species in various genera, described as new.

Wilson, E. H. America's greatest garden: the Arnold Arboretum. i–ii, 1–123. *illust.* Boston, 1925.

Wilson, E. H. *Rhododendron chrysocalyx* Lev. & Vaniot. Jour. Arnold Arbor. **6:** 200–201. O 1925.

Wilson, E. H. The family of *Euonymus*. House & Gard. **48:** 90–91, 148, 150, 154. *illust.* S 1925.

Wilson, R. S. Cotton rust. Mississippi Agr. Exp. Sta. Ext. Dept. Circ. 45: 1–2. S 1925.

Wingard, S. A. Studies on the pathogenicity, morphology, and cytology of *Nematospora Phaseoli*. Bull. Torrey Club **52:** 249–290. *pl. 7–9.* "Je" 4 N 1925.

Winston, J. R., Bowman, J. J., & Bach, W. J. Relative susceptibility of some Rutaceous plants to attack by the Citrus-scab fungus. Jour. Agr. Res. **30:** 1087–1093. "1 Je" Au 1925.

Wisherd, E. L., & Gayer, J. Canyons and Cacti of the American southwest. Natl. Geog. **48:** 275–290. *col. pl. 1–16.* S 1925.

Wolf, F. A. Some undescribed fungi on sourwood, *Oxydendron arboreum* (L.) DC. Jour. Elisha Mitchell Sci. Soc. **41:** 94–99. *pl. 5, 6.* S 1925.

Sphaerella caroliniana, Sphaerulina polyspora, Venturia oxydendri.